SUMMARY OF WORK

1. GENERAL

1.1 Work Covered by Construction Contract Documents

.1 Work of this Construction Contract comprises generally of the construction of a Scum Dewatering Building complete with odour control, yard piping, road works, landscaping, and connection to existing structures located at the City of Winnipeg North End Water Pollution Control Centre (NEWPCC). Work also includes upgrades to scum wasting in Primary Clarifiers 1, 2 and 3.

.2 The Work includes, but is not limited to the following elements:

.1 Install piles for the Scum Dewatering Building.

.2 Construction of concrete structure foundation over piles for the Scum Dewatering Building.

.3 Construction of the Scum Dewatering Building with associated mechanical, plumbing, HVAC, structural and architectural components, electrical, and instrumentation systems.

.4 Installation of pre-purchased dewatering rotary press (2) inclusive of polymer dosing system (2).

.5 Supply and installation of process, electrical, instrumental and control equipment for the Scum Dewatering Building.

.6 Supply and install all yard piping, fittings, couplings, transitions, connections, and valves.

.7 Supply and install odour control system.

.8 Supply consuming chemical including two (2) 1 m^3 totes of liquid cationic polymer.

.9 Complete all site work, site grading, paving, parking areas and Site Utility Work associated with the new facilities and with the general site.

.10 Replacement and installation of new scum pumps.

.11 Upgrade to the controls of the primary clarifier (1, 2 and 3) scum troughs.

.12 All other auxiliary equipment, structures, and systems required to complete the Work.

.12 Abate, load, transport and dispose of all known hazardous building materials including asbestos, requiring removal to complete the Work, prior to demolition.

1.2 Proposed Construction Plan

.1 Construct Work to allow continual treatment of wastewater with the existing system. Any interruptions in treatment to be coordinated with the City.

.2 Co-ordinate Progress Schedule with the City and Contract Administrator during construction to minimize disruption.

.3 Proposed construction plan includes:

.1 Site clearing.

.2 Excavation.

.3 Construction of Scum Dewatering Building foundation.

.4 Construction of Scum Dewatering Building structure.

.5 Installation of yard piping and connections to the existing Primary Clarifier Control Building.

.6 Supply and install process, mechanical and electrical systems in the Scum Dewatering Building.

.7 Replacement of scum pumps in the existing Primary Clarifier Control Building.

.8 Fully tie in scum, filtrate, wash water, potable water and all other necessary flows.

.9 Commissioning of new facility and performance testing.

.10 Landscaping and finishing works.

.11 The proposed work stages are not intended to capture all of the scope of work items and are only intended to highlight to the Construction Contractor that staging is required. The Construction Contractor may propose an alternate staging plan for review and approval by the City and Contract Administrator.

.4 Project milestones that form interim targets for the Construction Plan, include but are not limited to the following:

.1 Excavation completion date.

.2 Pile foundation completion date for Scum Dewatering Building.

.3 Scum Dewatering Building completion date.

.4 New scum piping completion date.

.5 Scum pump replacement completion date.

.6 Scum piping completion date.

.7 Yard piping completion date.

.8 Connection pipes to the Scum Dewatering Building.

.9 Interior finishing and fitting, mechanical, process mechanical, and electrical work completion date.

.10 Odour control systems.

.11 Electrical upgrades to the Primary Clarifier Control Building completion date.

.12 Control upgrades to Primary Clarifiers completion date.

.13 Interim Certificate (Substantial Completion).

1.3 Construction Contractor Use of Premises

.1 Co-ordinate use of premises under direction of Contract Administrator.

.2 Remove or alter existing Work to prevent injury or damage to portions of existing Work which remain.

.3 Repair or replace portions of existing Work which have been altered during construction operations to match existing or adjoining work, as directed by Contract Administrator.

1.4 City of Winnipeg Personnel Occupancy

.1 City of Winnipeg personnel will work around site during entire construction period for execution of normal operations.

.2 Co-operate with City of Winnipeg personnel in scheduling operations to minimize conflict.

.3 Provide continual access to the Existing Primary Clarification Facility south side of building and garage, unless otherwise planned with City of Winnipeg personnel for piping tie in to existing building.

1.5 City Supplied Equipment

.1 The following items will be supplied by the City to the General Contractor for installation, and integration into the Works.

.1 Two (2) Rotary Presses, complete with polymer feed systems, flocculation tanks and control panels.

1.6 Existing Services

.1 Where Work involves breaking into or connecting to existing forcemains, give fourteen (14) notice via City work request for all tie-ins and planned disruptions throughout course of work. Minimize duration and frequency of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance.

.2 Provide alternative routes for traffic.

.3 Before commencing work, complete hydrovac to establish location and extent of service lines in area of Work and notify the Contract Administrator of findings. Submit a report a minimum of four (4) weeks prior to starting any excavation work.

.4 Submit schedule to and obtain approval from the Contract Administrator for any shut-down or closure of active service or facility including power, wastewater, water and communications services. Adhere to approved schedule and provide notice to affected parties. Provide fourteen (14) notice via City work request for all tie-ins and planned disruptions.

.5 Provide temporary services to maintain operation of existing infrastructure and plant operation.

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

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

.8 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by Authorities Having Jurisdiction.

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

.10 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

.11 The Contractor is to use hydrovac processes to identify all structures or pipes.

.12 Due to daily flow variation, some of the tie-ins may be required to be completed during the night or at other low flow periods.

.13 Maintain access into the adjacent overhead door to the garage containing the tractor and notify the Contract Administrator with fourteen (14) days notice if the access is going to be impeded.

1.7 Documents Required

.1 Maintain at job site, one (1) copy of each document as follows:

.1 Construction Contract Drawings.

.2 Construction As-build Drawings.

.3 Specifications.

.4 Addenda.

.5 Reviewed Shop Drawings.

.6 List of Outstanding Shop Drawings.

.7 Change Orders.

.8 Other Modifications to Construction Contract.

.9 Field Test Reports.

.10 Copy of Approved Work Schedule.

.11 Health and Safety Plan and Other Safety Related Documents.

.12 Hazardous material management plan identifying hazardous materials, personal protective requirements and disposal arrangements.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

WORK RESTRICTIONS

1. GENERAL

1.1 Access and Egress

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

.2 The East-West Access Road shall remain open and accessible throughout the period of the project. If the road needs to be closed the contractor shall provide alternative access to the Primary Clarifier Building and access to the garage doors for the operational staff. A suggested location of a temporary road is shown on the Drawings. Do as instructed by Contract Administrator.

.3 The North-South Road shall remain open as reasonably possible.

1.2 Use of Site and Facilities

.1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with Contract Administrator to facilitate work as stated.

.2 Maintain existing primary clarification treatment.

.3 Maintain access to the garage doors and access doors.

.4 Where security is reduced by work provide temporary means to maintain security.

.5 Refer to Section 01 52 00 - Construction Facilities for information on sanitary facilities. Keep facilities clean.

.6 Closures: protect work temporarily until permanent enclosures are completed.

1.3 Alterations, Additions or Repairs to Existing Building

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

1.4 Existing Services

.1 Notify the City and utility companies of intended interruption of services or access and obtain required permission.

.2 Where Work involves breaking into or connecting to existing electrical services, give the City fourteen (14) day notice via City work request for all tie-ins and planned disruptions throughout course of work. Interruption to flows of wastewater require one week notice, and approval of the City. Keep duration of interruptions minimum. Carry out interruptions preferably during low flow times.

.3 Provide for personnel and vehicular traffic.

.4 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

1.5 Building Smoking Environment

.1 Comply with smoking restrictions. Smoking is not permitted.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

SUBSTITUTION PROCEDURES

1. GENERAL

1.1 Description

.1 Section includes administrative and procedural requirements for substitutions.

1.2 Definitions

.1 Substitutions for Cause: Changes proposed by the Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.

1.3 Submittals

.1 Submit Shop Drawings in accordance with Section 01 33 00.

.2 Substitution Requests: Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

.1 Substitution Request Form: Use Form 01 25 00-1 to request substitution.

.2 Documentation: Show compliance with requirements for substitutions and the following, as applicable:

.1 Justification for use of the proposed equivalent item(s), including evidence, as applicable, that Contract specified material, product, or equipment is unobtainable or unobtainable within an acceptable time for Contract completion.

.2 Statement indicating why specified product or fabrication or installation cannot be provided, if applicable. If the Contractor is proposing the substitution because of unavailability of the product, submit a letter from the manufacturer or distributor stating the product is unavailable with an explanation of why it is unavailable with the Form 01 25 00-1.

.3 Coordination information, including a list of changes or revisions needed to other parts of the Work, drawings and specifications, and to construction performed by City and separate contractors that will be necessary to accommodate proposed substitution.

.4 Detailed comparison of qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, electrical characteristics, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated and specified. Indicate deviations, if any, from the Work specified.

.5 Product data, including drawings and descriptions of products and fabrication and installation procedures.

.6 Certificates and qualification data, where applicable or requested.

.7 List of similar installations for completed projects with project names and addresses and names, telephone numbers, and addresses of engineers and owners.

.8 Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.

.9 Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.

.10 Cost information, including a proposal of change, if any, in the Contract Price.

.11 A prediction of any effects the proposed change will have on operation and maintenance costs, where applicable.

.12 Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is intended for applications indicated.

.13 Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

.3 Contract Administrator's Action: If necessary, Contract Administrator will request additional information or documentation for evaluation within five (5) Business Days of receipt of a request for substitution. The Contract Administrator will notify the Contractor of acceptance or rejection of a proposed substitution within fifteen (15) Business Days of receipt of request, or five (5) Business Days of receipt of additional information or documentation, whichever is later.

.1 Forms of Acceptance: Change Work Order, Proposed Change Notice, or Field Instructions for minor changes in the Work.

.2 Use product specified if Contract Administrator does not issue a decision on use of a proposed substitution within time allocated.

1.4 Material and Workmanship

.1 Whenever a material, article, system, or sub-system is specified or described by using the name and/or model of a proprietary product or trademark or the name of the manufacturer or vendor, the specified item shall establish the type, function, and quality required; it shall be understood that the words “or approved equal in accordance with B7” are implied whether or not they follow the proprietary enumeration.

.2 The Contract Administrator reserves the right to determine when proprietary items have no equivalency, and when uniformity of operations, interchangeability of parts, standard parts inventory, etc., are in the City’s best interest.

.3 Requests for review of equivalency will be considered upon submission of sufficient information as described herein, to allow complete review.

.4 Such requests will not be accepted from anyone other than the Contractor. Such submission must be made prior to purchase, fabrication, manufacture or use of the equivalent items under consideration.

.5 The Contractor is responsible for all delays caused by its failure to submit complete and accurate information with any request for approval of any material, article, system, or subsystem as an equivalent.

.1 Contractor Risk:

.1 If the Contractor includes in their Bid or later proposes any material, product, or equipment that they consider equivalent to that specified, the Contractor assumes all risk of any sort associated with acceptance or rejection of proposed equivalent items.

.2 The Contractor shall have no right to make claim based upon their Bid that includes a proposed equivalent item(s) of work which resulted in a lower Bid amount for said item(s) or lower total Bid.

.2 Equivalency:

.1 An item will be considered equivalent to the item specified if:

.1 It is equal or better in design and strength in all subparts, quality, reliability and durability, operation, maintenance, and serviceability, as applicable; and

.2 It is equal or better in specified parameters in performance in all respects for the specific function(s) indicated in the Contract.

.3 Supplemental Requirements:

.1 Any tests required by the Contract Administrator to establish quality and performance standards shall be promptly conducted by or through the Contractor at no additional cost to the City.

.2 The Contractor shall submit any additional data requested by the Contract Administrator for the equivalency review.

.3 The Contractor shall satisfactorily accomplish all changes, including any engineering associated with use of equivalent items, at no additional cost to the City.

.4 The Contractor shall have no right of appeal to any decision rejecting the equivalency of any item.

1.5 Quality Assurance

.1 Comply with the requirements specified in Section 01 45 00 - Quality Control.

.2 Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers at no cost to the City.

1.6 Procedures

.1 Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

2. PRODUCTS

2.1 Substitutions

.1 Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than fifteen (15) Business Days prior to time required for preparation and review of related submittals.

.1 Conditions: Contract Administrator will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Contract Administrator will return requests without action, except to record noncompliance with these requirements:

.1 Requested substitution is consistent with the Contract Documents and will produce specified and indicated results.

.2 Requested substitution provides sustainable design characteristics that specified product provided.

.3 Substitution request is fully documented and properly submitted.

.4 Requested substitution will not negatively affect Contractor's construction schedule.

.5 Requested substitution has received necessary approvals of Authorities Having Jurisdiction.

.6 Requested substitution is compatible with other portions of the Work.

.7 Requested substitution has been coordinated with other portions of the Work.

.8 Requested substitution provides specified warranty.

.9 If requested substitution involves more than one contractor, requested substitution has been coordinated, signed and confirmed with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

3. EXECUTION

3.1 Contract Closeout

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

Form 01 25 00-1
SUBSTITUTION REQUEST

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to design, including **Contract Administrator** design, detailing, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

_____

Telephone: _____

Attachments: _____

_____

_____

Contract Administrator REVIEW AND ACTION

☐ Substitution approved – Make submittals in accordance with Specification Section 01 25 00.

☐ Substitution approved as noted – Make submittals in accordance with Specification Section 01 25 00.

☐ Substitution rejected – Use specified materials.

☐ Substitution Request received too late – Use specified materials.

Signed by: _____ Date: _____

Additional Comments: ☐ Contractor ☐ Subcontractor ☐ Supplier ☐ Manufacturer ☐ Contract Administrator ☐
Other: _____

_____

_____

_____

_____

_____

Form 01 25 00-1 (Continued)
SUBSTITUTION REQUEST

Project: _____ Substitution Request Number: _____

_____ From: _____

To: _____ Date: _____

_____ Contract Administrator Project Number: _____

Re: _____ Contract For: _____

Specification Title: _____ Description: _____

Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Address: _____ Phone: _____

Trade Name: _____ Model No. _____

Installer: _____ Address: _____ Phone: _____

History: ☐ New product ☐ 1-4 years old ☐ 5-10 years ☐ More than 10 years old

Differences between proposed substitution and specified product: _____

_____

_____

☐ Point-by-point comparative data attached – REQUIRED BY Contract Administrator

Reason for not providing specified item: _____

_____

Similar Installation:

Project: _____ Contract Administrator: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other part of Work: ☐ No ☐ Yes, explain _____

_____

Savings to Owner for accepting substitution: _____

Proposed substitution changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____days.

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports _____

END OF SECTION

PAYMENT PROCEDURES FOR TESTING SERVICES

1. GENERAL

1.1 Testing Services

.1 The Construction Contractor will pay for testing services as follows:

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

.2 Inspection and testing performed exclusively for Construction Contractor's convenience.

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

.4 Mill tests and certificates of compliance.

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

.6 Tests as specified to be carried out by Construction Contractor in other Sections of these Specifications.

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

.8 Compaction testing with a nuclear densometer or a standard proctor test.

.9 Laboratory testing required for dewatering process commissioning.

.10 Standard proctor tests.

.11 Concrete testing as identified.

.12 Pipe pressure testing.

1.2 Construction Contractor's Responsibilities

.1 Provide labour, equipment and facilities to:

.1 Provide access to Work for inspection and testing.

.2 Facilitate inspections and tests.

.3 Make good Work disturbed by inspection and test.

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

.2 Notify Contract Administrator minimum seventy-two (72) hours in advance of operations to allow for witnessing of tests.

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

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

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

PROJECT MEETINGS

1. GENERAL

1.1 Administrative

.1 Schedule and administer project meetings throughout the progress of the Work at the call of the Contract Administrator.

.2 Prepare agenda for meetings.

.3 Distribute written notice of each meeting seven (7) days in advance of meeting date to Contract Administrator.

.4 Provide physical space and make arrangements for meetings.

.5 Preside at meetings.

.6 The Contract Administrator shall record the meeting minutes.

.7 Representative of the Construction Contractor, Subcontractor and Suppliers attending the meetings will be qualified and authorized to act on behalf of party each represents.

1.2 Weekly Newsletter

.1 The Contractor shall prepare weekly newsletters (including the weekly look-ahead schedules attached to the newsletters) and e-mail a PDF copy to the Contract Administrator and the City every Monday morning.

.2 Newsletters shall summarize the Work completed the previous week and shall include pictures associated with this Work. A detailed description of the work completed by all subcontractors/trades daily are to be included in the Newsletters, and not just the caption of the picture.

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

.4 At Substantial Performance, six (6) 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 (6) CDs updated at the end of the Warranty period to cover the entire project.

1.3 Underground Commissioning Reports

.1 Once any underground infrastructure (pipes, cables, ductbanks, tanks, etc.) is commissioned and prior to any backfilling, the Contractor is to provide the Contract Administrator with the underground commissioning report within five (5) days of completing the installation work prior to any backfilling.

.2 The underground commissioning report shall include at a minimum the following:

.1 Photographs of all locations of the installed infrastructure and include in the report with details showing the area, direction of view, description of the photograph, identification of any piping and equipment by tag number and English description and dates of completion.

.2 A site plan showing the locations of the various pictures shall also be clearly provided. The photographs captions shall be identified on the site plan for referencing purposes.

.3 Records of each testable joints, where applicable.

.4 Records of the hydrostatic pressure test for the installed pipe, where applicable.

.5 Records of the disinfection and neutralization procedure and results, where applicable.

.6 Records of the approval from the regulatory agency/authority, where applicable (e.g. ESA, TSSA, local hydro, gas utilities, etc.).

.7 A copy of the finalized Shop Drawing.

.3 The Contractor shall not commence any backfilling until these reports are submitted by Shop Drawings and approved by the Contract Administrator. The Contractor is required to conduct a site walk through of the installed infrastructure with the Contract Administrator to verify the accuracy of the underground commissioning report.

1.4 Preconstruction Meeting

.1 Within fifteen (15) days after award of the Construction Contract, request a meeting and organize of parties in Construction Contract to discuss and resolve administrative procedures and responsibilities.

.2 Senior representatives of the Contract Administrator, Construction Contractor, major Subcontractors, field inspectors and supervisors will be in attendance.

.3 Establish time and location of the meeting and notify parties concerned minimum five (5) days before meeting.

.4 Incorporate mutually agreed variations to Construction Contract Documents into Agreement, prior to signing.

.5 Agenda to include:

.1 Appointment of official representative of participants in the Work.

.2 Schedule of Work: in accordance with Section 01 32 16.07 - Progress Schedules.

.3 Schedule of submission of Shop Drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.

.4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences in accordance with Section 01 52 00 - Construction Facilities.

.5 Delivery schedule of specified equipment.

.6 Site security in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

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

.8 Record drawings in accordance with Section 01 33 00 - Submittal Procedures.

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

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

.11 Monthly progress claims, administrative procedures, photographs, hold backs.

.12 Appointment of inspection and testing agencies or firms.

.13 Insurances, transcript of policies.

1.5 Progress Meetings

.1 Schedule progress meetings twice a month during the course of Work and three (3) weeks prior to project completion.

.2 Construction Contractor and Contract Administrator are to be in attendance.

.3 Notify parties minimum seven (7) days prior to meetings.

.4 Contract Administrator to record minutes of meetings and circulate to attending parties and affected parties not in attendance within seven (7) days after meeting.

.5 Agenda to include the following:

.1 Review, approval of minutes of previous meeting.

.2 Review of Work progress since previous meeting.

.3 Field observations, problems, conflicts.

.4 Problems which impede construction schedule.

.5 Review of off-site fabrication delivery schedules.

.6 Corrective measures and procedures to regain projected schedule.

.7 Revision to construction schedule.

.8 Progress schedule, during succeeding work period.

.9 Review submittal schedules: expedite as required.

.10 Maintenance of quality standards.

.11 Review proposed changes for effect on construction schedule and on completion date.

.12 Other business.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

PROGRESS SCHEDULE

1. GENERAL

1.1 Definitions

.1 Activity: element of the Work performed during the course of the Project. Activity normally has an expected duration, and an expected cost and expected resource requirements. Activities can be subdivided into tasks.

.2 Bar Chart (GANTT Chart) (in Microsoft Project and PDF): graphic display of schedule-related information. In typical bar chart, activities or other Project elements are listed down the left side of chart, dates are shown across the top, and activity durations are shown as date-placed horizontal bars. Generally the Bar Chart shall be derived from commercially available computerized project management system.

.3 Baseline: original plan (for project, work package, or activity), plus or minus approved scope changes.

.4 Construction Work Week: Monday to Friday, inclusive, will provide five (5) day work week and define schedule calendar working days as part of Bar Chart (GANTT Chart) submission.

.5 Duration: number of work periods (not including holidays or other nonworking periods) required to complete activity or other project elements. Usually expressed as workdays or workweeks.

.6 Master Plan: summary-level schedule that identifies major activities and key milestones.

.7 Milestone: significant event in project, usually completion of major deliverable.

.8 Project Schedule: planned dates for performing activities and the planned dates for meeting milestones. A dynamic, detailed record of tasks or activities that must be accomplished to satisfy Project objectives. Monitoring and control process involves using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.

.9 Project Planning, Monitoring and Control System: overall system operated by the Contract Administrator to enable monitoring of project work in relation to established milestones.

1.2 Requirements

.1 Ensure Master Plan and Detail Schedules are practical and remain within specified Construction Contract duration.

.2 Plan to complete Work in accordance with prescribed milestones and time frame.

.3 Limit activity durations to maximum of approximately ten (10) working days, to allow for progress reporting.

.4 Ensure that it is understood that Award of Construction Contract or time of beginning, rate of progress, Interim Certificate and Final Certificate as defined times of completion are of essence of this Construction Contract.

1.3 Action and Informational Submittals

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

.2 Submit to Contract Administrator within fourteen (14) working days of Award of Construction Contract Bar Chart (GANTT Chart) as Master Plan for planning, monitoring and reporting of project progress.

.3 Submit Project Schedule to the Contract Administrator within five (5) working days of receipt of acceptance of Master Plan.

1.4 Project Milestones

.1 Project milestones that form interim targets for Project Schedule, include but are not limited to the following:

.1 Excavation completion date.

.2 Pile foundation completion date for Scum Dewatering Building.

.3 Scum Dewatering Building completion date.

.4 New scum piping completion date.

.5 Scum pump replacement completion date.

.6 Scum piping completion date.

.7 Yard piping completion date.

.8 Connection pipes to the Scum Dewatering Building.

.9 Interior finishing and fitting, mechanical, process mechanical, and electrical work completion date.

.10 HVAC and electrical upgrades to the Primary Clarifier Control Building completion date.

.11 Control upgrades to Primary Clarifiers completion date.

.12 Interim Certificate (Substantial Completion).

.13 Twenty (20) working days to be included in project slack as approved by the Contract Administrator.

1.5 Master Plan

.1 Structure the schedule to allow orderly planning, organizing and execution of the Work as Bar Chart (GANTT Chart).

.2 The Contract Administrator will review and return revised schedules within five (5) working days.

.3 Revise impractical schedule and resubmit within five (5) working days.

.4 Accepted revised schedule will become Master Plan and be used as baseline for updates.

1.6 Project Schedule

.1 Develop detailed Project Schedule derived from Master Plan.

.2 Ensure detailed Project Schedule includes as minimum milestone and activity types as follows:

.1 Award.

.2 Shop Drawings, Samples.

.3 Permits.

.4 Mobilization.

.5 Excavation.

.6 Piling.

.7 Yard Piping.

.8 Backfill.

.9 Building footings.

.10 Slab on grade.

.11 Structural Steel.

.12 Siding and Roofing.

.13 Interior Architecture (Walls, Floors and Ceiling).

.14 Process Equipment.

.15 Plumbing.

.16 Lighting.

.17 Electrical.

.18 Process Piping.

.19 Controls.

.20 Heating, Ventilating, and Air Conditioning.

.21 Millwork.

.22 Fire Systems.

.23 Testing and Commissioning.

.24 Supplied equipment long delivery items.

Paving.

1.7 Project Schedule Reporting

.1 Update Project Schedule monthly reflecting activity changes and completions, as well as activities in progress.

.2 Include as part of Project Schedule, narrative report identifying Work status to date, comparing current progress to baseline, presenting current forecasts, defining problem areas, anticipated delays and impact with possible mitigation.

1.8 Project Meetings

.1 Discuss Project Schedule at regular site meetings, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.

.2 Weather related delays with their remedial measures will be discussed and negotiated.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

CONSTRUCTION PHOTOGRAPHS

1. GENERAL

1.1 Construction Photographs

.1 Provide construction photographs pertinent to the Work as indicated and in compliance with Contract Documents.

.2 The Contractor must photographically document all areas and surrounding areas at all phases of the Contract including preconstruction, construction progress (weekly as a minimum) and post-construction.

.3 The Contractor must ensure that a digital camera is available at the Site for its own use and for the use of the Contract Administrator. 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.

.4 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 of the photograph and the work performed or being performed, and equipment tag no. and equipment description.

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

.5 Deliver to the City and Contract Administrator four prints of each exposure together with the negative (if applicable), and two electronic copies on CD-ROM or DVD-ROM. Digital photographs shall have high quality resolution taken at a minimum with an 8 megapixel camera. Video recording shall be at a minimum 1080p HD video recording (30 fps or 60 fps). The Contract Administrator may direct the Contractor to obtain additional photographic records of structures and features within the Site limit.

.6 The Contract Administrator 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.

.7 A complete set of photographs shall be prepared by the Contractor and submitted to the Contract Administrator in four (4) copies, plus four (4) 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 Contract Administrator.

2. SUBMITTALS

2.1 Pre-construction Photographs

.1 Electronic on USB.

.2 Identification: date of exposure and location in upper right-hand corner.

.3 Minimum three hundred (300) photos to portray the condition of all buildings, roads, yards, and surface features related to the Work prior to the commencement of construction.

2.2 Construction Progress Photographs

.1 Electronic on USB.

.2 Identification: date of exposure in upper right-hand corner.

.3 Minimum forty (40) photographs per month. Locations to be as directed by the Contract Administrator.

.4 Frequency: monthly with progress claims.

2.3 Post-Construction Photographs

.1 Submit final photographs taken after the date of Total Performance, and no later than ten (10) Business Days after Total Performance.

.2 Electronic on USB.

.3 Identification: date of exposure in upper right hand corner.

.4 Minimum three hundred (300) photographs. Locations to be as directed by the Contract Administrator.

3. PRODUCTS

3.1 Photographs

.1 Photographs: Provide images in JPG format, produced by a digital camera with minimum sensor size of 8 megapixels, and at an image resolution of not less than 3200 by 2400 pixels.

.2 Digital Video Recordings: Provide high-resolution, digital video on USB.

END OF SECTION

SUBMITTAL PROCEDURES

1. GENERAL

1.1 Administrative

.1 Within the first eight weeks of Notice to Proceed, the Contractor shall provide signed letters (on company letterheads) from the manufacturers of the following equipment, confirming that the Shop Drawings process has commenced for this project:

.1 Pumps.

.2 Valves.

.3 Piping.

.4 Motors.

.5 HVAC units.

.6 Bin covers.

.7 Truck scales.

.8 Odour treatment unit.

.9 MCCs.

.10 Overhead doors.

1.2 Description

.1 Submit to the Contract Administrator the submittals required by individual Specification sections for review. Submit promptly and in an orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.

.2 Submit Shop Drawings for 90% of the value of all materials within the first ten (10) weeks of Notice to Proceed and then remainder Shop Drawings within eight (8) weeks afterwards.

.3 Do not proceed with Work affected by the submittal until reviewed by the Contract Administrator.

.4 Present Shop Drawings, product data, and samples in SI Metric units.

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

.5 Review submittals prior to submission to Contract Administrator. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents.

.6 The review by the Contract Administrator is for the sole purpose of ascertaining conformance with general concept. It does not provide 'approval' of the detail design inherent in Shop

Drawings (which remains with the Contractor), nor does it relieve the Contractor of responsibility for errors or omissions in Shop Drawings or for meeting all requirements of the construction and Contract Documents.

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

.8 The Contractor shall make any corrections required by the Contract Administrator and shall resubmit the required number of corrected copies of submittals. The Contractor shall direct specific attention in writing on resubmitted submittals to revisions other than the corrections requested by the Contract Administrator on previous submission.

.9 After the Contract Administrator's review and return of copies, distribute copies to sub-trades as appropriate.

.10 Keep one (1) reviewed hard copy of each submission on Site filed by Division.

1.3 Submittal Procedures

.1 Direct submittals to the Contract Administrator.

.2 Hardcopy Submittals: Submit hard copies only where specifically required under individual Specifications sections.

.3 Electronic Submittals: Submittals made in electronic format shall be as follows:

.1 Each submittal shall be electronic file in Adobe Acrobat Portable Document Format (PDF), and native files (e.g. Word, Excel, AutoCAD, etc.). Use 2010 version or newer.

.2 Electronic files that contain more than ten (10) pages in PDF format shall contain internal book marking from index page to major sections of document.

.3 PDF files shall be set to open "Bookmarks and Page" view.

.4 Add general information to each PDF file, including title, subject, author, and keywords.

.5 PDF files shall be set up to print legibly at 215.9 mm by 279.4 mm (8.5" by 11"), 279.4 mm by 431.8 mm (11" by 17"), or ISO A1 (594 mm by 841 mm). No other paper sizes will be accepted.

.6 Submit new electronic files for each resubmittal.

.7 Include copy of transmittal of Contractor's submittal.

.8 Contract Administrator will reject submittals that are not accompanied by an electronic copy.

.9 Provide authorization for Contract Administrator to reproduce and distribute each file as many times as necessary for Project documentation.

.10 Detailed procedures for handling electronic submittals will be discussed at preconstruction meeting.

.11 Shop Drawings requiring an engineering seal shall be updated at project closeout and assigned a City of Winnipeg Water and Waste drawing number, sheet number, revision number and drawing size. Include fields in the Shop Drawing title block to incorporate the information.

.4 Schedule of Submittals:

.1 Prepare a table listing all anticipated submittals required to complete the Work.

.2 For each Specification Section show, at a minimum, the following:

.1 Specification Section.

.2 Total number of submittals for each Specification Section.

.3 Identify each submittal by its submittal number in accordance with a numbering and tracking system.

.4 Identify each submittal by its name or title.

.5 Identify the estimated date of submission to the Contract Administrator.

.6 State the revision number and status for each submittal.

.3 On a monthly basis, submit an updated schedule of submittals to the Contract Administrator if changes have occurred.

.5 Transmittal of Submittal:

.1 Stamp each submittal with uniform approval stamp before submitting to Contract Administrator.

.1 Stamp to include project name, submittal number, Specification number, Contractor's reviewer name, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with Contract.

.2 Contract Administrator will not review submittals that do not bear Contractor's approval stamp and will return them without action.

.3 Contract Administrator will not review submittals received directly from a Subcontractor and will return them without action.

.4 Complete, sign, and transmit with each submittal package, one (1) transmittal of Contractor's submittal form.

.2 Identify each submittal with the following:

.1 Numbering and tracking system:

.1 Sequentially number each submittal.

.2 Resubmission of submittal shall have original number with sequential alphabetic suffix.

.2 Specification Section and paragraph to which submittal applies.

.3 Project title and City Tender number (**463-2022**).

.4 Date of transmittal.

.5 Name of Contractor.

.3 Include Contractor's written response to each of Contract Administrator's review comments with resubmission of submittals stamped "Exceptions Noted, Resubmit".

.6 Format:

.1 Do not base Shop Drawings on reproductions of Contract Documents.

.2 Package submittal information by individual Specification Section. Do not combine different Specification Sections together in submittal package, unless otherwise directed in Specification.

.3 Present in a clear and thorough manner and in sufficient detail to show kind, size, arrangement, and function of components, materials, and devices, and compliance with Contract.

.4 Index with labeled tab dividers in orderly manner.

.7 Timeliness:

.1 Schedule and submit submittals in accordance with schedule of submittals and requirements of individual Specification Sections.

.2 Submit Shop Drawings and samples well in advance of scheduled delivery date for associated equipment or material and in an orderly sequence so as to cause no delay in the Work.

.8 Processing Time:

.1 Time for review shall commence on Contract Administrator's receipt of submittal.

.2 Contract Administrator will act upon Contractor's submittal and transmit response to Contractor not later than ten (10) Business Days after receipt, unless otherwise specified.

.3 Resubmittals will be subject to the same review time.

.4 The review time required will not alleviate the Contractor of his responsibility to deliver the completed Work within the required time frame and schedule. Planning for submittal reviews and the risk to the construction schedule remains the Contractor's sole responsibility.

.9 Resubmittals:

.1 Clearly identify each correction or change made and include revision date.

.2 No adjustment of the schedule outlined in the Supplemental Conditions or Contract Price will be allowed due to delays in progress of Work caused by rejection and subsequent resubmittals.

.10 Incomplete Submittals:

.1 The Contract Administrator will return the entire submittal for the Contractor's revision if preliminary review deems it incomplete.

.2 Incomplete Shop Drawing information will be considered as stipulated deductions for the purposes of progress payment certificates.

.3 When any of the following are missing, the submittal will be deemed incomplete:

.1 Contractor's review stamp, completed and signed.

.2 Transmittal of Contractor's Submittal form, completed and signed.

.3 Insufficient number of copies.

.4 All requested information is not provided.

.5 Submittals missing Professional Engineer's seal and signature, where it is required.

.11 Submittals not required by Contract:

.1 Will not be reviewed and will be returned stamped "RECEIVED FOR INFORMATION".

.2 Contract Administrator will keep one (1) copy of all Shop Drawings and Product Data.

1.4 Shop Drawings and Product Data

.1 The term "Shop Drawing" as defined in the City's General Conditions for Construction (Revision 2020-01-31) means all drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are prepared by the Contractor, Subcontractor, manufacturer, supplier, or distributor and which illustrate some portion of the Work.

.2 In general, all equipment to be installed at the Site will require Shop Drawings, which shall be submitted to the Contract Administrator.

.3 Sales bulletins or other general publications are not acceptable as submittals for review except where necessary to provide supplemental technical data.

.4 Adjustments made on Shop Drawings by the Contract Administrator are not intended to change the Contract Price. If adjustments affect the value of the Work state such in writing to the Contract Administrator prior to proceeding with the Work. Failure to give such written notice shall waive the Contractor's right to seek additional time or cost under the requirements of the Contract.

.5 All Shop Drawings are to include details as follows:

.1 Indicate dimensions, operating weights, materials, methods of construction, and attachment of support wiring, diagrams, connections, recommended installation details, explanatory notes, and other information necessary for completion of Work.

.2 Where equipment is connected to other equipment, indicate that such items have been coordinated, regardless of the section under which the adjacent items will be supplied and installed. Indicate cross-references to Drawings and Specifications.

.3 Indicate clearances for operation, maintenance, and replacement of operating equipment devices.

.4 Include a markup specification section for each item, showing compliance with the spec with a checkmark and any deviations need to be explained.

.6 Electrical and instrumentation and control system Shop Drawings to include additional details as follows:

.1 Elevation layouts, bill of materials (BOM), fuse charts, schematics, interconnections, point-to-point wiring diagrams, loop wiring diagrams, motor control diagrams, single line diagram, 3-line diagram, and CSA/cUL panel plates in addition to the other wiring and detail requirements of the Contract.

.1 Panel plates shall be included in submissions, to be affixed on the front exterior door of the enclosure. They shall contain all information required under CSA C22.1 and C22.2. At a bare minimum the short circuit current rating (SCCR) of panel plates shall be equal to the MCC or Panelboard from which they are fed from.

.2 Wiring diagrams shall mark conductor identification, field terminals, changes, etc.

.3 Detailed listing of all nameplates.

.4 Identification in accordance with the City of Winnipeg Water & Waste Identification Standard (https://winnipeg.ca/waterandwaste/pdfs/dept/IdentificationStandard.pdf)

.2 Instrument Loop Diagrams (ILDs) – detailed drawings showing typical interconnections for the specified instrumentation and control devices. The Contractor is to reproduce an ILD for each device and record all relevant notes and installation-specific information on each sheet. Update the ILDs as necessary and fill in all terminal and wiring numbers, etc. from relevant Shop Drawings as they become available.

.1 Loop wiring diagrams shall follow ISA 5.4 for standard drawing layout, symbols, and wiring depictions.

.3 Motor Control Schematics (MCS) – when these are included, they are detailed drawings showing typical interconnections of motor control equipment. The Contractor is to reproduce a MCS for each motor and record all relevant notes and installation-specific information on each sheet. Update the MCS as necessary and fill in all terminal and wiring numbers, etc. from relevant Shop Drawings as they become available.

.4 Equipment descriptive data and detailed information for the system hardware and software (i.e., cutsheets or product literature). Failure to provide product literature or cutsheets with drawing submissions is grounds for marking the submission “Revise and Resubmit” without review.

.1 High-light only relevant information for the products provided. The intent of the literature is a technical review of the products suitability, technical ratings and limitations, and the installation/application. Do not include sales literature, or custom-made sheets, or sales declarations. Only manufacturer issued technical literature will be accepted.

.2 Where products have configurable part numbers, the part number options shall be broken down and either circled in red or highlighted in yellow.

.3 All cutsheets and product literature shall be provided showing CSA or cUL markings either circled in red or highlighted in yellow.

.4 Where hazardous location products are required, they shall also be submitted with their CSA or cUL certificates, and CSA or cUL required wiring diagrams for hazardous installations. The control system wiring diagrams shall capture these requirements, provide intrinsically safe barriers and methods as required, and provide notes for the electrical installer.

.5 Drawings for cabling:

.1 Provide Termination drawings with complete list of materials and nameplate engraving list.

.2 Provide Interconnection wiring diagrams for the complete system showing every fibre in each cable.

.6 Records of as-built information for the complete instrumentation and control system.

.1 Provide Enclosure/Cabinet temperature control calculations for heating and cooling loads. Appropriate temperature control shall be provided whenever required and maintain the enclosures CSA/NEMA rating.

.1 Temperature calculations shall be provided whenever Variable Frequency Drives (VFD), Variable Speed Drives (VSD), internally mounted transformers, or other components/devices may produce sufficient heat within the enclosure, or as requested by the Contract Administrator.

.7 Notify the Contract Administrator in writing of any deviations in Shop Drawings from the requirements of the Contract.

.1 Contract Administrator will not assume the responsibility for searching out deviations in the Contractor's drawings.

.2 If works proceeds without notifying the Contract Administrator, the Contractor bears all responsibilities in regards to time and costs to rectify the issue at no cost to the City.

.8 Submit Shop Drawings stamped and signed by Professional Engineer registered or licensed in the Province of Manitoba as required in the Specifications. The following components require sealed Shop Drawings:

.1 Reinforcing steel.

.2 Metal fabrications.

.3 Pipe supports, hangers and anchors.

.9 The Contractor shall examine all Shop Drawings prior to submission to the Contract Administrator to ensure that all necessary requirements have been determined and verified and that each Shop Drawing has been checked and coordinated with the requirements of the Work and the Contract. Examination of each Shop Drawing shall be indicated by stamp, date, and signature of a responsible person of the Subcontractor for supplied items and of the Contractor for fabricated items. Shop Drawings not stamped, signed, and dated will be returned without being reviewed and stamped " REVISE AND RESUBMIT ". Ensure that the following are verified:

.1 Field measurements.

.2 Field construction criteria.

.3 Catalogue numbers and similar data.

.4 Coordination/confirmation between all drawings and specification.

.5 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.

.10 Submittals shall be in one (1) of the following formats:

.1 Submit three (3) copies of white prints and three (3) copies of all fixture cuts and brochures.

.2 Submit one (1) electronic PDF copy.

.11 Shop Drawings will be returned to the Contractor with one (1) of the following notations:

.1 When stamped "REVIEWED" or "NO EXCEPTIONS TAKEN", distribute additional copies as required for execution of the Work.

.2 When stamped "REVIEWED AS MODIFIED" or "MAKE NOTED CORRECTIONS", ensure that all copies for use are modified and distributed, same as specified for "REVIEWED".

.3 When stamped "REVISE AND RESUBMIT", make the necessary revisions, as indicated, consistent with the Contract and submit again for review.

.4 When stamped "NOT REVIEWED" or "REJECTED", submit other Shop Drawings, brochures, etc., for review consistent with the Contract.

.5 Only Shop Drawings bearing "REVIEWED", "NO EXCEPTIONS TAKEN", "MAKE NOTED CORRECTIONS", or "REVIEWED AS MODIFIED" shall be used on the Work unless otherwise authorized by the Contract Administrator.

.12 After submittals are stamped "REVIEWED", "NO EXCEPTIONS TAKEN", "MAKE NOTED CORRECTIONS" or "REVIEWED AS MODIFIED", no further revisions are permitted unless re-submitted to the Contract Administrator for further review.

.13 Make changes in Shop Drawings, which the Contract Administrator may require, consistent with Contract. When re-submitting, notify the Contract Administrator in writing of any revisions other than those requested by the Contract Administrator.

.14 Only two (2) reviews of Shop Drawings will be made by the Contract Administrator at no cost. Each additional review will be charged to the Contractor at the Contract Administrator's scheduled rates. The Contract Administrator's charges for the additional Work will be deducted from the payment to the Contractor.

.15 All final reviewed Shop Drawings with red lines shall be drafted as original documents (CAD) with no red lines. These shall then be incorporated into the Operations and Maintenance Manuals.

1.5 Description of Construction Methods

.1 The Contractor shall, submit for the review of the Contract Administrator method statements which describe in detail, supplemented with Drawings where necessary, the methods to be adopted for executing any portion of Work.

.2 These statements shall also include details of constructional Plant and labour to be employed. Acceptance by the Contract Administrator shall not relieve the Contractor of any of his responsibilities, nor shall reasonable refusal to approve entitle the Contractor to extra payment or an extension of time.

.3 Other Considerations:

.1 Fabrication, erection, installation, or commissioning may require modifications to equipment or systems to conform to the design intent. Revise pertinent Shop Drawings and resubmit.

1.6 Requests for Information

.1 In the event that the Contractor or any Subcontractor involved in the Work, determines that some portion of the Drawings, Specifications, or other Contract documents requires clarification or interpretation by the Contract Administrator, the Contractor shall submit a Request for Information (RFI) Form in writing to the Contract Administrator.

.2 Submission Procedure:

.1 Submit RFI's to the Contract Administrator on the "Request for Information" form appended to this Section. The Contract Administrator shall not respond to a RFI except as submitted on this form. The link to the City's RFI form is provided below:

https://www.winnipeg.ca/infrastructure/templates/ExecutionControl/Request_for_Information_(RFI)_v2.0.docx

.2 Number RFI's consecutively in one sequence in order submitted, in a numbering system established by the Contract Administrator.

.3 Submit one (1) distinct subject per RFI request. Do not combine unrelated items on one (1) form.

.4 Where RFI form does not have sufficient space, attach additional sheets as required.

.5 Submit with RFI form all necessary supporting documentation.

.3 In the RFI, the Contractor shall clearly and concisely set forth:

.1 the issue for which clarification or interpretation is sought and why a response is needed from the Contract Administrator; and

.2 an interpretation or understanding of the requirement along with reasons why such an understanding was reached.

.4 The Contract Administrator will review all RFIs to determine whether they are valid RFIs. If it is determined that the document is not a valid RFI, it will be returned to the Contractor not having been reviewed with an explanation why it was deemed not valid.

.5 An RFI response shall be issued within ten (10) Business Days of receipt of the request from the Contractor unless the Contract Administrator determines that a longer time is necessary to provide an adequate response. When the RFI submission is received by the Contract Administrator before noon, the review period commences on that Business Day. When the RFI submission is received by the Contract Administrator after noon, the review period commences on the subsequent Business Day.

.6 If, at any time, the Contractor submits a large number of RFI's or the Contract Administrator considers the RFI to be of such complexity that the Contract Administrator cannot process the RFI's within ten (10) Business Days, the Contract Administrator shall confer with the Contractor within five (5) Business Days of receipt of such RFI's and the Contract Administrator and the Contractor will jointly prepare an estimate of the time necessary for processing same as well as an order of priority among the RFI's submitted. The Contractor shall accommodate such necessary time at no impact to the schedule and at no additional cost to the Contract.

.7 If the Contractor submits a RFI on an activity with ten (10) Business Days or less of available time to the impacted activity on the current project schedule, the Contractor shall not be entitled to any time extension due to the time it takes the Contractor Administrator to respond to the request provided that the Contract Administrator responds within the ten (10) Business Days set forth above.

.8 An RFI response from the Contract Administrator will not change any requirement of the Contract. In the event the Contractor believes that the RFI response from the Contract Administrator will cause a change to the requirements of the Contract, the Contractor shall within ten (10) Business Days give written notice to the Contract Administrator stating that the Contractor believes the RFI response will result in a change to the Contract and the Contractor intends to submit a change request. Failure to give such written notice of ten (10) Business Days shall waive the Contractor's right to seek additional time or cost under the requirements of the Contract.

1.7 Closeout Submittals

.1 Refer to Section 01 78 00 - Closeout Submittals for closeout submittal requirements.

1.8 Miscellaneous Submittals

.1 Prepare and submit submittals required Contract Documents.

.1 Submit manufacturer's instructions, printed product literature and data sheets for hazardous materials and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit hazardous materials management plan to Contract Administrator that identifies hazardous materials, usage, location, personal protective equipment requirements, and disposal arrangements.

.3 Copies: Submit one (1) electronic copy to Contract Administrator. Method of electronic submission to be coordinated with Contract Administrator after execution of the Contract.

.1 Submit hard copies for paint samples and other submittals where specifically required under individual Specifications Sections.

.4 The Contract Administrator will review submittals for general conformance with design concept and intent, and general compliance with Contract.

.5 The Contract Administrator’s review does not relieve Contractor from compliance with requirements of Contract nor from errors in submittals or Contractor’s design.

.6 The Contractor is responsible for confirmation of dimensions at jobsite; fabrication processes; means, methods, techniques, sequences, and procedures of construction; coordination of work of all trades; and performance of Work in safe and satisfactory manner.

.7 At the Contract Administrator’s option, the Contract Administrator’s review comments and review stamp will be placed either directly on submitted copies of submittals or on separate submittal review comment form.

.8 Where work is to be designed by the Contractor, comply with applicable codes and furnish submittals signed and sealed by Professional Engineer licensed in Province of Manitoba, as required by Specifications. All calculations shall be submitted for review. Calculations shall also be signed and sealed by a Professional Engineer registered in the Province of Manitoba.

1.9 General Requirements for Submittals

.1 Details regarding submittals can be found in the individual Specification Sections.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

SUBMITTAL PROCEDURES

For details and instructions on how to complete this document, click the [¶] icon under the Home tab to display the hidden text.

RFI Title: _____ **RFI No.:** 0

Date RFI initiated: _____ **Date Response Requested by:** _____

Date Response Issued: _____

Project Name: _____

Submitted To:			
Contract Administrator (CA):		Consultant Ref. No.	
Company/Dept.:		Tender No.	

Requested By:		***For CA Use***	
Name:		City File No.:	
Title:		Project ID:	
Company:		Project Record Index No.:	
Email::		Purchase Order No.:	

Request/Question: (to be completed by Contractor)

Answer/Response: (to be completed by Contract Administrator)

Attachment(s):

Distribution (to be completed by Contract Administrator)

- Contract Administrator
- Contractor
- City Project Manager
- Other:

END OF SECTION

ENVIRONMENTAL PROTECTION

1. GENERAL

1.1 Section Includes

.1 Definitions:

.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.

.2 Reference Standards:

.1 U.S. Environmental Protection Agency (EPA)/Office of Water.

.2 EPA 832/R-92-005-92, Storm Water Management for Construction Activities, Chapter 3.

1.2 General

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

.2 Prior to commencing construction activities or delivery of materials to Site, provide Environmental Protection Plan for review by Contract Administrator.

.3 Ensure Environmental Protection Plan includes comprehensive overview of known or potential environmental issues to be addressed during construction.

.4 Address topics at level of detail commensurate with environmental issue and required construction task(s).

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

.6 Control noise level in accordance with local by-laws.

.7 Prevent dust nuisance resulting from construction operations at all locations on the site and inside the filter tanks and piping gallery. Erect hoarding and tarp off the work area as necessary to prevent dust accumulation to working equipment. Erect tarps around the existing PAC panel, instrumentation and equipment as directed by the Contract Administrator.

.8 Protect existing services, land, vegetation, and water courses.

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

.10 Include in Environmental Protection Plan:

.1 Name(s) of person(s) responsible for ensuring adherence to Environmental Protection Plan.

.2 Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from Site.

.3 Name(s) and qualifications of person(s) responsible for training site personnel.

.4 Descriptions of environmental protection personnel training program.

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

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

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

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

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

.10 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, are contained on the project site.

.11 Contaminant Prevention Plan identifying potentially hazardous substances to be used on job Site; intended actions to prevent introduction of such materials into air, water, or ground; and detailing provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.

.12 Waste Water Management Plan identifying methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines.

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

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

1.3 Measures

.1 Noise Control:

.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 facility roads 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 station access road from the Gate 1 & 2 entrance to the facility and construction site with street sweeper vehicle weekly. 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 weekly until Substantial Performance Date. This activity shall not be terminated at anytime during this period unless directed by the Contract Administrator.

.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 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 Contract Administrator.

.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 Refueling Areas

.1 Review all proposed construction areas to plan access routes and fuelling areas.

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

.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 m 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 or aquifers.

1.6 Spills

.1 Submit procedures for interception, rapid clean-up and disposal of any spillage that may occur, for the Contract Administrator’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 MOECC Spills Centre, the City's Sewer Use Group and the Contract Administrator.

1.7 Use of Pesticides

.1 Coordinate the use of herbicides, pesticides and fungicides with landowners and occupants and Regional Pesticides Control Office 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 Contract Administrator in writing of the particular schedule for each watercourse 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 Contract Administrator.

.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 Obtain waiver from landfill site releasing the City 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 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 City is designated as the "Constructor" as a result of the Contractor's actions, any increases in the Contractor's or the City'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.

1.11 Historical/Archaeological Control

.1 Provide historical, archaeological, cultural resources plan that defines procedures for identifying procedures to be followed if historical archaeological, and cultural resources not previously known to be on Site or in the area are discovered during construction.

.2 Plan: include methods to assure protection of known or discovered resources and identify lines of communication between Construction Contractor personnel and the Contract Administrator.

1.12 Fires

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

1.13 Notification

.1 The Contract Administrator will notify the Construction Contractor in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Construction Contractor's Environmental Protection plan.

.2 The Construction Contractor after receipt of such notice will inform the Contract Administrator of proposed corrective action.

.3 Do not take action until after receipt of written approval by Contract Administrator.

.4 The Contract Administrator will issue stop order of work until satisfactory corrective action has been taken.

.5 No time extensions granted or equitable adjustments allowed to Construction Contractor for such suspensions.

2. PRODUCTS (NOT USED)

3. EXECUTION

3.1 Cleaning

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

.2 Ensure public waterways, storm and sanitary sewers remain free of waste and volatile materials disposal.

END OF SECTION

MEASUREMENT AND PAYMENT

1. GENERAL

1.1 References

.1 City of Winnipeg/Construction Contractor Agreement.

1.2 General

.1 In addition to covering the cost of various items of Work for which the Contract Unit Prices and Contract Lump Sum Prices are set forth in the Contract, the Contract Prices so set forth shall be held to cover and shall cover the cost of furnishing all materials, plant, tools, equipment, labour, services, transportation and incidentals necessary for executing the Work required of the Contractor under the terms of the Contract, Plans and Specifications, and the observing, performing and keeping of all the terms, covenants and conditions of the Contract all of which shall be observed, performed and kept by the Contractor. Any item of Work not specifically listed under Contract Unit or Lump Sum Prices shall be considered incidental to such other items as are listed.

.2 Items measured in lineal metres shall be measured to the nearest whole metre unless otherwise stated.

.3 Items measured in square metres shall be measured to the nearest square metre unless otherwise stated.

.4 Items measured in cubic metres shall be measured to the nearest cubic metre unless otherwise stated.

.5 Items measured in hectares shall be measured to the nearest one tenth of a hectare unless otherwise stated.

.6 Items measured in tonnes (from a certified scale) shall be measured to the nearest 1/100 tonne unless otherwise stated. The Contractor shall supply certified weight tickets to the Contract Administrator at the time of delivery of each load to the Site.

.7 No measurement and payment shall be made for “common excavation”, “bedding”, “common backfill” and “compacted common backfill” as described in the Contract Documents. The Work as described shall be considered incidental as detailed herein. There shall be no separate payment for these items.

.8 No measurement and payment shall be made for fittings as described in the Contract Documents. All fittings shall be considered incidental to the pipe the fitting is associated with as detailed herein. There shall be no separate payment for these items.

1.3 Schedule of Values

.1 Provide Schedule of Values for lump sum items for itemized evaluation of payment estimates. Schedule is to be supported by evidence as Contract Administrator may reasonably request. Once accepted by the Contract Administrator, they will be used as background basis for applications for payment.

.2 Include statement based on Schedule of Values with each application for payment.

1.4 Measurement and Payment

.1 Payment for work performed under the various Divisions of the Construction Contract shall be made at the respective Lump Sum Price or Unit Price for that item as indicated.

.2 General Conditions:

.1 Measurement for “General Conditions” will be based on the percentage of dollar value of work completed vs. the total contract price.

.2 Payment for General Conditions shall be lump sum as specified in the contract unit price for “General Conditions”. Insurance and Bonding, loading assembly, transporting and setting up of the contractors’ equipment, additional facilities and tools and supplies and all works for moving the items away when the project is completed and all other such works shall be considered incidental. Payment will be equal to the tendered unit price regardless of the actual final contract value of work completed. General Conditions shall include Division 1. Unless otherwise noted all testing is the responsibility of the Contractor and shall be considered incidental to this item. Any water or other resources required for testing are the responsibility of the Contractor.

.3 Civil and Site Works:

.1 Method of Measurement: All yard piping and Civil Works starting at 1 m outside of structures (Scum Dewatering Building, Primary Clarifier Control Building, Clarifiers) shall be on a unit price basis. The Work shall also include:

.1 Road Works related to the supply and installation of access roads, tie into existing road, parking area, embankments for built up areas and other Site improvements as required in the specifications including fill material, geocombo material, granular material, and signage.

.2 Placing of Topsoil and Seeding.

.3 All erosion control works as needed for environmental protection and as detailed in these specifications are considered incidental to this item.

.4 Yard piping between Scum dewatering Building and Primary clarifier control building.

.2 Basis of Payment: Payment shall be based on unit price basis for all related works. The price shall include all labour, equipment, and material for the completion of the Civil and Site Works according to the Drawings and Specifications. Civil and Site Works shall include but is not limited to the works defined in Divisions 31, 32 and 33 of these Specifications.

.4 Supply and Install Rock- Socketed Caissons:

.1 Method of Measurement: Supply and install rock-socketed caissons will be measured on a length basis and paid at the Contract Unit Price per linear metre.

.2 Basis of Payment: Price shall be payment in full for supplying all materials and for completing all operations associated with Supply and Install Rock- Socketed Caissons

as described in Section 31 63 19.11 and all other items incidental to the work included in this Specification and accepted by the Contract Administrator.

.5 Supply of Steel Casing Tips:

.1 Method of Measurement: Supply of steel casing tips will be measured on a unit basis and the number to be paid for will be the total number of steel casing tips supplied as accepted by the Contract Administrator.

.2 Basis of Payment: Price shall be payment in full for supply of steel casing tips for performing all operations associated with Supply of Steel Casing Tips as described in Section 31 63 19.10 and all other items incidental to the work included in this Specification, accepted and measured by the Contract Administrator.

.6 Installation of Steel Casing Tips:

.1 Method of Measurement: Installation of steel casing tips will be measured on a unit basis and the number to be paid for will be the total number of steel casing tips installed as accepted by the Contract Administrator.

.2 Basis of Payment: Price shall be payment in full for installation of steel casing tips for performing all operations associated with Installation of Steel Casing Tips as described in Section 31 63 19.10 and all other items incidental to the work included in this Specification, accepted and measured by the Contract Administrator.

.7 Scum Dewatering Building Superstructure:

.1 Method of Measurement: Complete construction of the scum building superstructure work will be measured on a lump sum basis. The superstructure shall include all works performed above grade for the scum building, these include but are not limited to the pre-engineered building, walls, roof and all other miscellaneous items required to achieve compliance with drawings and specifications.

.2 Basis of Payment: Payment shall be based on a lump sum basis for all related works. The price shall include all labour, equipment, and material for the completion of the superstructure according to the Drawings and Specifications. Superstructure works shall include but is not limited to the works defined in Divisions 2, 3, 4, 5, 6, 7, 8, 9, and 10.

.8 Scum Dewatering Building Substructure:

.1 Method of Measurement: Complete construction of the scum building substructure work will be measured on a lump sum basis. The substructure shall include all works performed below grade, these include but are not limited to excavation, backfill, concrete works, supply and installation of precast piles, supply and installation of precast pile tips, splicing of piles and all other miscellaneous items required to achieve compliance with drawings and Specifications.

.2 Basis of Payment: Payment shall be based on a lump sum basis for all related works. The price shall include all labour, equipment, and material for the completion of the substructure according to the Drawings and Specifications. Substructure works shall include but is not limited to the works defined in Divisions 3, 6, 7, and 9.

.9 Process Works (Complete Project):

.1 Method of Measurement: Measurement for Process as shown on the plans and described in the Specifications shall be on a lump sum basis. Work includes pumps, process and mechanical equipment, chemical dosing systems, pressure testing, valves and piping, blowers and aeration systems and all associated work.

.2 Basis of Payment: Payment shall be based on a lump sum basis for all related works. The price shall include all pumps, process piping, flushing water piping, installation of process equipment, chemical supply, chemical tanks, and forcemain tie in coordination, on a lump sum basis within 1 m of the Scum Dewatering Building structure (including odour control). Process Works includes but is not limited to the works defined in Divisions 40, 41, 43, 44 and 46. This work also includes process pumps and piping in the Primary Clarifier Control Building.

.10 Mechanical Works (Complete Project):

.1 Method of Measurement: Measurement for Mechanical as shown on the plans and described in the Specifications shall be on a lump sum basis. Work includes all mechanical systems for the building including heating, plumbing, air distribution, air conditioning and all associated work.

.2 Basis of Payment: Payment shall be based on a lump sum basis for all related works. The price shall include all labour, equipment and material for the completion of the Mechanical work according to the Drawings and Specifications. All works related to mechanical systems and all associated components, shall be incidental to the works. Mechanical Works shall include but is not limited to the works define in Divisions 21, 22 and 23.

.11 Electrical and Instrumentation & Controls Works (Complete Project):

.1 Method of Measurement: Measurement for Electrical and Instrumentation & Controls as shown on the plans and described in the Specifications shall be on a lump sum basis. Work includes electrical equipment systems, instrumentation and control systems and all associated work.

.2 Basis of Payment: Electrical and instrumentation and control shall include electrical work, instrumentation and controls, SCADA systems, computer systems, and permits coordination for electrical power supply on a lump sum basis. Permit costs are paid as a separate line item. Routing the electrical service from the Customer Service Terminal Enclosure (CSTE) to the scum building and all other site electrical works is considered incidental to this item; coordination as required with Manitoba Hydro is considered incidental to this item. Installation of Internet and Phone Service from the property line to the scum building is considered incidental to this item. Internet and phone service installation shall be coordinated with Valley Fiber as needed. Coordination with Valley Fiber as required shall be considered incidental to this item. Electrical Instrumentation & Controls Works shall include but is not limited to the works defined in Divisions 23, 26 and 40.

.12 Commissioning, Demonstration and Training:

.1 Method of Measurement: Measurement for Commissioning, Demonstration and Training as described in the Specifications shall be on a lump sum basis. Work includes acceptance, equipment delivery, equipment installation training, equipment installation, and equipment performance testing and commissioning for all equipment and all associated work.

.2 Basis of Payment: Payment shall be based on a lump sum basis for all related works. The price shall include all labour, equipment and material for the completion of the Commissioning, Demonstration and Training according to the Specifications for new and related existing equipment. All works related to start-up, commissioning, training, equipment installation and testing unless specifically noted as a unit price item, shall be incidental to the works. Commissioning, Demonstration and Training shall include but is not limited to the works defined in Division 1.

.13 Closeout Submittals:

.1 Method of Measurement: Measurement for Closeout Submittal as described in the Specifications shall be on a lump sum basis. Work includes hard and electronic copies of Operating and Maintenance Manuals for all pieces of equipment or material that are contained within Specifications and all associated work, red line drawings and final survey.

.2 Basis of Payment: Payment shall be based on a lump sum basis for all related works. The price shall include all labour, equipment and material for the completion of the O&M Manuals, red line drawings and final survey according to the Drawings and Specifications. All works related to hard and digital copies of O&M Manuals, red line drawings and final survey shall be incidental to the works. Closeout Submittals shall include but is not limited to the works defined in Section 01 78 00 – Closeout Submittals.

.14 Building Permit:

.1 Method of Measurement: Measurement for the building permit will be on a lump sum basis.

.2 Basis of Payment: Work shall include procuring and submitting the building permit at the established price as detailed in the Schedule of Prices.

.15 Extra Work Allowance:

.1 Payment for Extra Work shall only be incorporated into the Construction Contract with approval the City and the Contract Administrator.

.1 The Extra Work Allowance includes allowance for asbestos abatement in the existing primary clarifier building.

1.5 Items Covered

.1 Construction Contract Prices:

.1 In addition to covering the cost of various items of work for which the Construction Contract Unit Prices and Construction Contract Lump Sum Prices are set forth in the Construction Contract, the Construction Contract Prices so set forth shall be held to cover

and shall cover the cost of furnishing all materials, plant, tools, equipment, labour, services, transportation and incidentals necessary for executing the work required of the Construction Contractor under the terms of the Construction Contract, Plans and Specifications, and the observing, performing and keeping of all the terms, covenants and conditions of the Construction Contract all of which shall be observed, performed and kept by the Construction Contractor. Any item of Work not specifically listed under Construction Contract Unit or Lump Sum Prices shall be considered incidental to such other items as are listed.

.2 If pipe installation by horizontal directional drilling/tunnelling/coring has **not been** specifically indicated on the Drawings and the installation method is optional to the Construction Contractor, it shall not be considered for payment under the item where trenchless installation is listed on the Tender Form. Likewise there shall be no differentiation in measurement or payment based on method of installation for locations where a specific method of installation is not specified on the Drawings.

1.6 Substantial Performance of Work

.1 Submit Final Operation and Maintenance Manuals as per Section 01 78 00, complete with all required commissioning reports. Final Operation and Maintenance Manuals approved by the Contract Administrator and complete with all required commissioning reports are required prior to Substantial Performance.

.2 Completed As-Built Drawings are required prior to Substantial Performance.

.3 Prepare and submit to the Contract Administrator a comprehensive list of items to be completed or corrected and apply for a review by the Contract Administrator to establish Substantial Performance of Work or substantial performance of designated portion of Work when Work is substantially performed if permitted by lien legislation applicable to Place of Work designated portion which the City agrees to accept separately is substantially performed. Failure to include items on list does not alter responsibility to complete Construction Contract.

.4 No later than ten (10) days after receipt of list and application, The Contract Administrator will review the Work to verify the validity of the application, and no later than seven (7) days after completing the review, will notify the Construction Contractor if the Work or designated portion of the Work is substantially performed.

.5 The Contract Administrator will state the date of Substantial Performance of Work or designated portion of the Work in certificate.

.6 Immediately following the issuance of certificate of Substantial Performance of Work, in consultation with the Contract Administrator, will establish a reasonable date for finishing Work.

1.7 Payment of Holdback Upon Substantial Performance of Work

.1 After issuance of certificate of Substantial Performance of Work:

.1 Submit application for payment of holdback amount.

.2 Submit sworn statement that accounts for labour, subcontracts, products, construction machinery and equipment, and other indebtedness which may have been incurred in

Substantial Performance of Work and for which the City might be held responsible have been paid in full, except for amounts properly retained as holdback or as identified amount in dispute.

.2 After receipt of application for payment and sworn statement, Contract Administrator will issue certificate for payment of holdback amount.

.3 Where holdback amount has not been placed in a separate holdback account, the City shall, ten (10) days prior to expiry of the holdback period stipulated in lien legislation applicable to Place of Work, place the holdback amount in a bank account in joint names of the City and Construction Contractor.

.4 The amount authorized by certificate for payment of holdback amount is due and payable on the next Wednesday following the expiration of the holdback period stipulated in lien legislation applicable to Place of Work. Where lien legislation does not exist or apply, the holdback amount is due and payable in accordance with other legislation, industry practice, or provisions which may be agreed to between parties. The City may retain, out of the holdback amount, sums required by law to satisfy liens against Work or, if permitted by lien legislation applicable to Place of Work, other third party monetary claims against the Construction Contractor which are enforceable against the City.

1.8 Final Payment

.1 Submit application for final payment when the Work is completed.

.2 The Contract Administrator will, no later than ten (10) days after receipt of application for final payment, review Work to verify validity of application. The Contract Administrator will give notification that the application is valid or give reasons why it is not valid, no later than seven (7) days after reviewing Work.

.3 The Contract Administrator will issue final certificate for payment when application for final payment is found valid.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

REGULATORY REQUIREMENTS

1. GENERAL

1.1 Permits/ Inspections

.1 Arrange and pay for the regulatory submittals and inspections necessary for the completion of the Work in accordance with Federal, Provincial, and District laws, regulations, and by-laws.

.2 Within one (1) week of receipt, provide one (1) copy of all regulatory reports, permits, and other documents to the Contract Administrator. Include any reports related to Construction Contractor operations on the Site.

.3 The Contractor shall send Electrical Drawings to Manitoba Hydro with confirmation of acceptance within three (3) weeks of Contract Award.

1.2 References and Codes

.1 Conform to all Federal, Provincial, and District Codes, regulations and by-laws.

.2 Perform Work in accordance with the National Building Code of Canada (NBC) including amendments up to the tender closing date and other codes of provincial or local application provided so that in case of conflict or discrepancy, the more stringent requirements apply.

.3 Meet or exceed requirements of:

.1 Construction Contract Documents.

.2 Specified standards, codes and referenced documents.

.4 In the event of discrepancies between codes, standards or other provisions, the most stringent shall apply.

1.3 Building Smoking Environment

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

1.4 Visitors

.1 Make available four (4) “visitor” safety helmets, four (4) safety glasses and four (4) vests for authorized visitors.

.2 Ensure that visitors are provided safety orientation.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

QUALITY CONTROL

1. GENERAL

1.1 References

.1 Within the text of the Specifications, reference may be made to the following standards:

.1	ACI	American Concrete Institute
.2	AISC	American Institute of Steel Construction
.3	ANSI	American National Standards Institute
.4	ASTM	American Society for Testing and Materials
.5	AWWA	American Water Works Association
.6	CANI	National Standard of Canada
.7	CEC	Canadian Electric Code (published by CSA)
.8	CGA	Canadian Gas Association
.9	CGSB	Canadian Government Specification Board
.10	CISC	Canadian Institute of Steel Construction
.11	CLA	Canadian Lumberman's Association
.12	CPCA	Canadian Printing Contractors Association
.13	CPCI	Canadian Pre-stressed Concrete Institute
.14	CRCA	Canadian Roofing Construction Association
.15	CSA	Canadian Standards Association
.16	DIN	Deutsches Institut Normung
.17	EEMAC	Electrical and Electronic Manufacturer's Association of Canada
.18	EIB	Electrical Inspection Branch
.19	FMEC	Factory Manual Engineering Corporation
.20	IEEE	Institute of Electrical and Electronic Engineers
.21	IPCEA	Insulated Power Cable Engineers Association
.22	NAAMM	National Association of Architectural Metal Manufacturers
.23	NACE	National Association of Corrosion Engineers

.24 NBC National Building Code

.25 NEMA National Electric Manufacturers Association

.26 NFPA National Fire Protection Association

.27 ULC Underwriters Laboratories of Canada

.2 Conform to the latest version of such standards available at the time of tendering, in whole or in part, as specified.

.3 If there are questions as to whether any product or system is in conformance with applicable standards, the Contract Administrator reserves the right to have such products or systems tested to prove or disprove conformance with Construction Contract Documents, or by the Construction Contractor in the event of non-conformance.

1.2 Inspection

.1 Allow the Contract Administrator access to the Work. If part of the Work is in preparation at locations other than the Place of Work, allow access to such Work whenever it is in progress.

.2 Give minimum seventy-two (72) hours notice when requesting inspection if the Work is designated for special tests, inspections or approvals by the Contract Administrator, or law of Place of Work.

.3 If the Construction 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 at no cost to the City.

.4 The Contract Administrator will order part of the Work to be examined if Work is suspected to be not in accordance with the Construction Contract Documents. If, upon examination such Work is found not in accordance with the Construction Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with the Construction Contract Documents, the City shall pay cost of examination.

1.3 Independent Inspection Agencies

.1 Where inspecting, testing and similar quality control services are specifically indicated in the Specification Sections as the Construction Contractor's responsibility, the Construction Contractor shall engage appropriate Independent Inspection/Testing Agencies. The cost of such services will be borne by the Construction Contractor.

.2 The City may elect to engage Independent Inspection/Testing Agencies for the purpose of quality assurance inspecting and/or testing portions of the Work. The cost of such services will be borne by the City.

.3 Where the City has engaged an Inspection/Testing Agency for testing and inspection of a part of the Work and the Construction Contractor is also required to engage an Inspection/Testing Agency for the same or related part of the Work; the Construction

Contractor shall not employ the same agency engaged by the City without the prior written approval of the City.

.4 All equipment required for carrying out the above inspection and testing will be provided by the appointed agencies.

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

.6 If defects are revealed during inspection and/or testing, the appointed agency will request additional inspection and/or testing to ascertain the full degree of defect. Correct the defect and irregularities as advised by the City at no cost to the City. Pay costs for retesting and re-inspection.

1.4 Access to Work

.1 Allow inspection/testing agencies access to Work, off Site manufacturing and fabrication plants.

.2 Co-operate to provide reasonable facilities for such access.

1.5 Procedures

.1 Notify appropriate agency and the Contract Administrator in advance of requirement for tests, in order that attendance arrangements can be made.

.2 Submit samples and/or materials required for testing, as specifically requested in the Specifications. Submit with reasonable promptness and in orderly sequence to not cause delays in Work.

.3 Provide labour and facilities to obtain and handle samples and materials on Site. Provide sufficient space to store and cure test samples.

1.6 Rejected Work

.1 Remove defective Work, whether the result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by the Contract Administrator as failing to conform to the Construction Contract Documents. Replace or re-execute in accordance with the Construction Contract Documents.

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

.3 If in the opinion of the Contract Administrator it is not expedient to correct defective Work or Work not performed in accordance with the Construction Contract Documents, The Contract Administrator will deduct from the Construction Contract Price the difference in value between Work performed and that called for by the Construction Contract Documents, the amount of which will be determined by the Contract Administrator.

1.7 Reports

.1 Submit one (1) electronic copy of inspection and test reports to the Contract Administrator.

.2 Provide copies to the Subcontractor of work being inspected or tested and to the manufacturer or fabricator of material being inspected or tested.

.3 Each report shall include:

.1 Date of issue.

.2 Construction Contract name and number.

.3 Name, address and telephone number of Inspection/Testing Agency.

.4 Name and signature of inspector and tester.

.5 Date of inspection or test.

.6 Identification of the Product and Specification Section covering inspected or tested Work.

.7 Location of the inspection or the location from which the tested product was derived.

.8 Type of inspection or test.

.9 Complete inspection or test data.

.10 Test results and an interpretation of test results.

.11 Ambient conditions at the time of sample taking and testing.

.12 The remarks and observations on compliance with the Construction Contract Documents.

.13 Recommendations on retesting or other corrective action where necessary.

.14 Signature of a qualified and authorized representative of the Agency.

.4 Submit reports within forty-eight (48) hours; notwithstanding, notify the Contract Administrator immediately if the test indicates improper conditions or procedures.

.5 Refer to Specification section for definitive requirements.

1.8 Tests and Mix Designs

.1 Furnish test results and mix designs as requested.

.2 Cost of tests and mix designs beyond those called for in the Construction Contract Documents or beyond those required by-law of Place of Work will be appraised by the Contract Administrator and may be authorized as recoverable.

1.9 Mill Tests

.1 Submit mill test certificates as requested or as required.

1.10 Equipment and Systems

.1 Submit adjustment and balancing reports for process, mechanical, electrical and building equipment systems as indicated in Section 01 33 00.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

TEMPORARY UTILITIES

1. GENERAL

1.1 Action and Informational Submittals

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

1.2 Installation and Removal

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

.2 Remove from Site all such work after use.

1.3 Water Supply

.1 The Construction Contractor shall use potable water.

.2 All water is to be obtained and paid for by the Contractor. If a tie-in to the City service is allowed, install backflow preventer. All water will be metered and priced back to the Contractor.

1.4 Wastewater Collection

.1 The construction contractor will not have a temporary service for wastewater at Site. This must be collected and hauled by a licenced hauler.

1.5 Temporary Heating and Ventilation

.1 Provide temporary heating required during the construction period, including attendance, maintenance and fuel.

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

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

.1 Facilitate progress of Work.

.2 Protect Work and Products against dampness and cold.

.3 Prevent moisture condensation on surfaces.

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

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

.4 Maintain temperatures of minimum 10°C in areas where construction is in progress.

.5 Ventilating:

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

.2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into the 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.

.6 Permanent heating system of building, to be used when available. Be responsible for damage to heating system if use is available. Power and gas costs to be paid for by the Contractor.

.7 On completion of Work for which permanent heating system is used, calibrate and service the HVAC system, replace filters, clean and return to a like new state.

.8 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 the outside.

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

1.6 Temporary Power and Light

.1 Provide and pay for temporary power during construction for temporary lighting and operating of power tools.

.2 Arrange for connection with appropriate utility company. Pay costs for installation, maintenance and removal.

.3 Provide and maintain temporary lighting throughout the Project. Ensure level of illumination on all floors and stairs is not less than 162 lux.

.4 Electrical power and lighting systems installed under this Construction Contract may be used for construction requirements only with prior approval of the Contract Administrator provided that guarantees are not affected. Make good damage to electrical system caused by use under this Construction Contract. Replace lamps which have been used for more than three (3) months.

1.7 Temporary Communication Facilities

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

1.8 Fire Protection

.1 Provide and maintain temporary fire protection equipment during performance of the Work required by the insurance companies having jurisdiction and governing codes, regulations and by-laws.

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

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

CONSTRUCTION FACILITIES

1. GENERAL

1.1 References

.1 Canadian General Standards Board (CGSB):

.1 CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.

.2 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.

.2 Canadian Standards Association (CSA International):

.1 CSA-A23.1/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.2 CSA-0121-M1978(R2003), Douglas Fir Plywood.

.3 CAN/CSA-S269.2-M1987(R2003), Access Scaffolding for Construction Purposes.

.4 CAN/CSA-Z321-96(R2001), Signs and Symbols for the Occupational Environment.

1.2 Action and Informational Submittals

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

1.3 Installation and Removal

.1 Prepare site plan indicating proposed location and dimensions of area to be fenced and used by the Construction Contractor, number of trailers to be used, avenues of ingress/egress to fenced area and details of fence installation.

.2 Identify areas which have to be gravelled to prevent tracking of mud.

.3 Indicate use of supplemental or other staging area.

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

.5 Remove from Site all such Work after use.

1.4 Scaffolding

.1 Scaffolding in accordance with CAN/CSA-S269.2.

.2 Provide and maintain scaffolding, ramps, ladders, swing staging, platforms, temporary stairs and all other construction items necessary to complete the Work.

1.5 Hoisting

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

.2 Hoists and cranes to be operated by qualified operator.

1.6 Site Storage/Loading

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

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

1.7 Construction Parking

.1 Parking will be permitted on Site in an area as directed by the Contract Administrator provided it does not disrupt performance of the Work or operation of the existing treatment facilities.

.2 Provide and maintain adequate access to Project Site.

1.8 Security

.1 Maintain a secure site, with fencing.

1.9 Offices

.1 Provide for the sole use of the Contract Administrator and the City, a field trailer as specified.

.1 Supply and maintain a trailer, satisfactory to the Contract Administrator and City, for the exclusive use of the Contract Administrator and City for the duration of the Contract until at least three (3) months following Substantial Performance.

.2 Trailer to consist of a minimum of the following rooms inside the trailer:

.1 Office for City with own door with lock and key.

.2 Office for Contract Administrator with own door with lock and key.

.3 Meeting Room to fit a minimum of twelve (12) chairs and persons.

.4 Washroom.

.5 Storage Room.

.6 Kitchen.

.3 The trailer to be set up in approved location within fourteen (14) 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 Contract Administrator, 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 300 mm above ground level and having a floor area of not less than 50 m^2 and 2.6 m ceiling height.

.8 Equip the storage room with:

.1 One plan table with sloping top approximately 2.0 m long, 1.0 m wide and 960 mm high; with smooth plywood top.

.2 Two (2) stools, approximately 710 mm high for the above plan table.

.3 Three (3), three-tier wooden bookcases.

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

.9 Equip each office with:

.1 One (1) new standard office desk having three lockable drawers.

.2 One (1) new swivel type office chair with adequate ergonomic and lumbar support.

.3 One (1) legal-size, 4 drawer file cabinet with lock and key.

.4 One (1) standard four drawer, legal-size, lockable, steel filing cabinet with three (3) sets of keys.

.5 One (1), three tier wooden bookcase.

.6 One (1) telephone with One (1) phone line (separate to others) complete with voicemail, caller ID and call waiting. Phone to be supplied is capable of call display and speaker.

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

.8 One (1) wastepaper basket.

.10 Equip meeting room with:

.1 A 3.0 m x 1.25 m meeting table.

.2 Twelve (12) standard office chairs.

.3 Fire extinguisher and first aid kit.

.4 Whiteboard with two (2) sets of markers.

.5 Portable projector screen.

.6 One (1) 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.

.7 One (1) wastepaper basket.

.11 Equip kitchen with:

.1 One (1) combination hot and cold water cooler.

.2 One (1) standard refrigerator, minimum 0.5 m^3 (18 ft^3).

.3 One (1) standard microwave.

.4 One (1) hot and cold water sink with dishwashing soap and rags.

.5 Cabinetry with drawers to store napkins, paper towels, dishes and cutlery along with a minimum set of six (6) plates, cups, knives, forks and spoons.

.6 One (1) waste basket.

.12 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°C year round.

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

.5 Electrical outlets in each office, storage room and meeting room (4 minimum) as required.

.13 Provide doors to the trailer and to each office with suitable locks. Main door to the trailer shall come with at least eight (8) sets of keys.

.14 Provide at least two windows within the meeting room and one window within each office and the kitchen, each window having a size of at least 2.0 m^2 on the opposite wall in which the exterior door is located. Provide window shades with screens.

.15 Provide washroom facilities with hot and cold sink, toilet, waste basket and mirror for the sole use of the Contract Administrator and the City. Maintain a supply of paper towels, toilet paper, and soap throughout the duration of the project.

.16 Provide weekly janitorial services and all washroom supplies.

.17 Provide heat tracing to prevent freezing of pipes when not in use.

.18 Provide one (1) printer/copier/scanner multi-function machine 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 GB.

.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%, 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.

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

.20 Provide Wi-Fi and high speed mobile Internet (minimum internet speed of 5 Gbps download and 1 Gbps upload) access suitable for a unlimited monthly usage. Pay for the monthly charges by the Internet service provider. Internet access shall be designated for the Contract Administrator's trailer and shall not be shared with the Contractor's trailer.

.21 Provide connection services in each office and meeting room for the printer. Provide technical services to assist the Contract Administrator, City and its representatives to connect to the Wi-Fi and printing system.

.22 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 Contract Administrator and its agents against loss by fire, theft and injury to the building, to the office or its contents.

.23 Maintain the field office and the performance of the office equipment as specified until at least three (3) months following Substantial Performance.

.24 Provide parking space with a satisfactory wearing surface to accommodate three (3) vehicles minimum. Provide a walkway from the office doors to the parking area and keep both free of water, mud, ice and snow.

1.10 Equipment, Tool and Materials Storage

.1 Provide and maintain, in clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.

.2 Locate materials not required to be stored in weatherproof sheds on site in manner to cause least interference with work activities.

1.11 Sanitary Facilities

.1 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 Contract Administrator.

.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 Contract Administrator's or City's facilities.

.6 The Contractor is to secure premises to prevent use by external parties. Provide signage as necessary.

1.12 Construction Signage

.1 No signs or advertisements, other than those required by funding parties or other than warning and traffic signs, are permitted on Site.

.2 Signs and notices for safety and instruction to CAN/CSA-Z321.

.3 Maintain approved signs and notices in good condition for duration of project and dispose of off Site on completion of project or earlier if directed by the Contract Administrator.

1.13 Protection and Maintenance of Traffic

.1 Provide access and temporary relocated roads as necessary to maintain traffic.

.2 Maintain and protect traffic on affected roads during the construction period except as otherwise specifically directed by the Contract Administrator.

.3 Provide measures for protection and diversion of traffic, including provision of watch-persons and flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger, and direction signs.

.4 Protect travelling public from damage to person and property.

.5 Construction Contractor's traffic on roads selected for hauling material to and from Site to interfere as little as possible with public traffic.

.6 Verify adequacy of existing roads and allowable load limit on these roads. Construction Contractor: responsible for repair of damage to roads caused by construction operations.

.7 Construct access and haul roads necessary.

.8 Haul roads: constructed with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic shall be avoided.

.9 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.

.10 Dust control: adequate to ensure safe operation at all times.

.11 Location, grade, width, and alignment of construction and hauling roads: subject to approval by the Contract Administrator.

.12 Lighting: to assure full and clear visibility for full width of haul road and work areas during night work operations.

.13 Provide snow removal during period of Work.

.14 Remove, upon completion of work, haul roads designated by the Contract Administrator.

1.14 Clean-Up

.1 Remove construction debris, waste materials, packaging material from Work Site daily.

.2 Clean dirt or mud tracked onto paved or surfaced roadways.

.3 Store materials resulting from demolition activities that are salvageable.

.4 Stack stored new or salvaged material in construction facilities.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

TEMPORARY BARRIERS AND ENCLOSURES

1. GENERAL

1.1 References

.1 Canadian General Standards Board (CGSB):

.1 CGSB 1.59-(97), Alkyd Exterior Gloss Enamel.

.2 CAN/CGSB 1.189-(00), Exterior Alkyd Primer for Wood.

.2 Canadian Standards Association (CSA International):

.1 CSA-O121-(M1978(R2003)), Douglas Fir Plywood.

1.2 Installation and Removal

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

.2 Remove from Site all such work after use.

1.3 Hoarding

.1 Erect temporary site enclosures using 38 x 89 mm construction grade lumber framing at 600 mm centres and 1200 x 2400 x 13 mm exterior grade fir plywood to CSA O121.

.2 Apply plywood panels vertically flush and butt jointed.

1.4 Guard Rails and Barricades

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

.2 Provide as required by governing authorities.

1.5 Weather Enclosures

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

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

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

1.6 Dust Tight Screens

.1 Provide dust tight screens or partitions to localize dust generating activities, and for protection of workers, finished areas of Work and public.

.2 Maintain and relocate protection until such work is complete.

1.7 Access to Site

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

1.8 Fire Routes

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

1.9 Protection for Off-Site and Public Property

.1 Protect surrounding private and public property from damage during performance of Work.

.2 Be responsible for damage incurred.

1.10 Protection of Building Finishes

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

.2 Provide necessary screens, covers, and hoardings.

.3 Confirm with Contract Administrator locations and installation schedule three (3) days prior to installation.

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

1.11 Waste Management and Disposal

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Construction Waste Management Disposal.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

1. GENERAL

1.1 Description

.1 This Section contains the general requirements of products, materials and workmanship. This Section supplements but does not supersede specific requirements found elsewhere in the Construction Contract.

1.2 Products and Materials

.1 Quality:

.1 Products, materials, equipment and articles incorporated in the Works to be new, not damaged or defective, and of the best quality compatible with Specifications for the purpose intended.

.2 Defective products, whenever identified will be rejected, regardless of previous inspections. Remove and replace defective products and be responsible for delays and expenses caused by rejection.

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

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

.5 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.

.6 Preliminary acceptance of equipment or Products listed by supplier names will not in any way constitute a waiver of the Specifications covering such equipment; final acceptance will be based on full conformity with the Construction Contract.

.2 Availability:

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

1.3 Manufacturer's Instructions

.1 Unless otherwise indicated in the Specifications, install or erect products in accordance with Manufacturer's instructions.

.2 Notify the Contract Administrator a minimum of four (4) weeks prior to installation, in writing, of conflicts between the Specifications and Manufacturer's instructions.

.3 Improper installation or erection of products, due to failure in complying with these requirements, to be removed and reinstalled at no increase in Construction Contract Price.

1.4 Workmanship

.1 General:

.1 Employ only workers experienced and skilled in the respective duties for which they are employed to obtain workmanship of the best quality.

.2 Coordination:

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

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

.3 Coordinate all the work of all Subcontractors.

.4 Confirm in writing that all Subcontractors examine the full set of Drawings and Specifications for other parts of the Works which may affect the performance of their work.

.5 Ensure that sleeves, openings and miscellaneous foundations are provided as required for the Works.

.6 Ensure that items to be built in are supplied when required with all necessary templates, measurements and Shop Drawings.

.3 Protection of Work in Progress:

.1 Protect work completed or in progress. Work damaged or defaced due to failure in providing such protection is to be removed and replaced, or repaired at no cost to the City.

.2 Prevent overloading of any structure.

.4 Remedial:

.1 Remedy, repair or replace the 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 the materials affected. Perform in a manner to neither damage nor endanger any portion of Works.

1.5 Quantities

.1 Schedules of equipment piping, fittings, or other materials indicating quantity and/or dimension, which are shown in the Construction Contract, are not guaranteed to be accurate and are to be checked by the Construction Contractor.

.2 Claims for additional payment resulting from variations between quantities shown and those actually installed will not be accepted.

1.6 Metric Project

.1 This Work is designed and is to be constructed in the SI Metric system of measurements.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

COMMON PRODUCT REQUIREMENTS

1. GENERAL

1.1 References

.1 Within text of each specification section, reference may be made to reference standards.

.2 Conform to these reference standards, in whole or in part as specifically requested in the Specifications.

.3 If there is question as to whether products or systems are in conformance with applicable standards, the Contract Administrator reserves the right to have such products or systems tested to prove or disprove conformance.

.4 Cost for such testing will be borne by the City in event of conformance with Construction Contract Documents or by the Construction Contractor in event of non-conformance.

.5 Conform to latest date of issue of referenced standards in effect on date of submission of Bids.

1.2 Quality

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

.2 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is a precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.

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

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

.5 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 to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.

.2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in the Work.

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

.4 Store cementious 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 and lumber. on flat, solid supports and keep clear of ground. Slope to shed moisture.

.7 Store and mix paints in a heated and ventilated room. Remove oily rags and other combustible debris from Site daily. Take every precaution necessary to prevent spontaneous combustion.

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

.9 Touch-up damaged factory finished surfaces to Contract Administrator's satisfaction. Use touch-up materials to match original. Do not paint over nameplates.

1.4 Transportation

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

1.5 Manufacturer's Instructions

.1 Unless otherwise indicated in the Specifications, install or erect products in accordance with the Manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.

.2 Notify the Contract Administrator in writing, of conflicts between the Specifications and the Manufacturer's instructions, so that the Contract Administrator will establish course of action.

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

1.6 Quality of Work

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

.2 Do not employ anyone unskilled in their required duties. The Contract Administrator reserves the right to require dismissal from Site workers deemed incompetent or careless.

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

1.7 Co-Ordination

.1 See to the co-operation of workers in laying out Work. Maintain efficient and continuous supervision.

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

1.8 Concealment

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

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

1.9 Remedial Work

.1 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.10 Location of Fixtures

.1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.

.2 Inform the Contract Administrator of conflicting installation. Install as directed.

1.11 Fastenings

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

.2 Prevent electrolytic action between dissimilar metals and materials.

.3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in the affected Specification Section.

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

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

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

1.12 Fastenings - Equipment

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

.2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use Type 316 stainless steel for exterior areas.

.3 Bolts may not project more than one diameter beyond nuts.

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

1.13 Protection of Work In Progress

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

1.14 Existing Utilities

.1 When breaking into or connecting to existing services or utilities, execute the Work at times directed by local governing authorities and or the Contract Administrator, with a minimum of disturbance to the Work, and/or building occupants, pedestrian and vehicular traffic.

.2 Protect, relocate or maintain existing active services. When services are encountered, cap off in a manner approved by the Authority Having Jurisdiction. Stake and record the location of the capped service.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

EQUIPMENT INSTALLATION

1. GENERAL

1.1 Expertise and Responsibility

.1 The Contract Administrator recognizes the expertise of the Manufacturer.

.2 Should the Contract Administrator issue an Addendum, Field Order, Change Order, or Instruction to change the Work which would, in the opinion of the Construction Contractor, compromise the success or safety of the Work, then it shall be incumbent on the Construction Contractor to notify in writing the Contract Administrator to this effect within two (2) days.

1.2 Equipment Delivery

.1 Ten (10) days before delivery, notice shall be given to the Contract Administrator so that arrangements for receipt and inspection can be made. The shipping lists of materials will be carefully checked by the Manufacturer's Representative in the presence of the Contract Administrator and the Construction Contractor. When the Construction Contractor accepts the equipment delivery, he shall certify the delivery by completing Form 100 – Certificate of Equipment Delivery, attached to this Specification.

.2 The Construction Contractor shall be responsible for all equipment at the Site or any alternative storage location.

.3 The Construction Contractor shall ensure that he is fully informed of precautions to be taken in the unloading of the equipment and subsequent storage including any required maintenance.

.4 If off Site storage of equipment is required, then the second move of the equipment to the Site will be at the Construction Contractor's cost.

1.3 Installation Assistance

.1 Before commencing installation of the equipment, the Construction Contractor shall arrange for the attendance of the Manufacturer's Representative to provide instructions in the methods, techniques, precautions, and any other information relevant to the successful installation of the equipment.

.2 The Construction Contractor shall inform the Contract Administrator, in writing, of the attendance at the Site of any Manufacturer's Representative for installation training at least fourteen (14) days prior to arrival.

.3 When the Manufacturer's Representative is satisfied that the Construction Contractor is aware of all installation requirements, he shall so certify by completing Form 101 – Certificate of Readiness to Install attached to this Specification.

.4 The completed form shall be delivered to the Contract Administrator prior to departure of the Manufacturer's Representative from the Site.

.5 Installation of the equipment shall not commence until the Contract Administrator has advised that he has received the completed Form 101.

.6 Separate copies of Form 101 shall be used for different equipment.

1.4 Installation

.1 If necessary, or if so directed by the Contract Administrator during the course of installation, the Construction Contractor shall contact the Manufacturer's Representative to receive clarification of installation procedures, direction, or any other additional information necessary to continue or complete the installation in an appropriate manner.

.2 If it is found necessary, or if so directed by the Contract Administrator, the Construction Contractor shall arrange for the Manufacturer's Representative to visit the Site to provide assistance during installation, all at the Construction Contractor's cost.

.3 Prior to completing installation, the Construction Contractor shall inform the Manufacturer's Representative and arrange for the attendance at the Site of the Manufacturer's Representative to verify successful installation.

.4 The Manufacturer's Representative shall conduct a detailed inspection of the installation including alignment, electrical connections, belt tensions, rotation direction, running clearances, lubrication, workmanship and all other items as required to ensure successful operation of the equipment.

.5 The Manufacturer's Representative shall identify any outstanding deficiencies in the installation.

.6 The deficiencies shall be rectified by the Construction Contractor and the Manufacturer's Representative will be required to re-inspect the installation, at the Construction Contractor's cost.

.7 When the Manufacturer's Representative accepts the installation, he shall certify the installation by completing Form 102 – Certificate of Satisfactory Installation, attached to this Specification.

.8 Deliver the completed Form 102 to the Contract Administrator prior to departure of the Manufacturer's Representative from the Site.

.9 Tag the equipment with a 100 mm by 200 mm card stating "EQUIPMENT CHECKED. DO NOT RUN." stencilled in large black letters. Sign and date each card.

.10 Provide separate copies of Form 102 for different equipment.

1.5 Operation and Performance Verification

.1 Equipment will be subjected to a demonstration, running test, and performance test after the installation has been verified and any identified deficiencies have been remedied.

.2 During the demonstration, running tests, and performance tests, the Construction Contractor shall operate equipment as required to complete the Performance Verification required from all Divisions of this Specification.

.3 Inform the Contract Administrator at least fifteen (15) days in advance of conducting the tests and arrange for the attendance of the Manufacturer's Representative.

.4 The Manufacturer's Representative shall conduct all necessary checks to the equipment and if necessary, advise the Construction Contractor of any further checking, flushing, cleaning, or other work needed prior to confirming the equipment is ready to run.

.5 The Construction Contractor shall then operate the equipment for at least one (1) hour to demonstrate the operation of the equipment and any required ancillary services. Any remedial measures required to ensure satisfactory operation shall be promptly undertaken.

.6 Demonstration:

.1 The Construction Contractor shall then notify the Contract Administrator of his readiness to demonstrate the operation of the equipment. The Contract Administrator shall attend, as expeditiously as possible.

.2 With the assistance of the Manufacturer's Representative, the Construction Contractor shall demonstrate that the equipment is properly installed. Alignment, piping connections, electrical connections, etc. will be checked and if appropriate, code certifications provided.

.3 The equipment shall then be run for one (1) hour. Local controls shall be verified by cycling the equipment through several start-stop operations, modulating its output, or some combination. Operating parameters such as temperature, pressure, voltage, vibration, etc., will be checked to ensure that they are within the specified or Manufacturer's Representative's recommended limits, whichever is more stringent.

.4 On satisfactory completion of the one (1) hour demonstration, the equipment shall be stopped and critical parameters, such as alignment, shall be rechecked.

.7 Running Test:

.1 The equipment shall be restarted and run continuously for a minimum of three (3) days (seventy-two (72) hours) with clean water or as specified. During this period, as practicable, conditions shall be simulated which represent maximum or most severe, average, and minimum or least severe conditions. These conditions will be mutually agreed to by the Manufacturer's Representative, the Construction Contractor, and the Contract Administrator on the basis of the information contained in the technical specifications, as well as the methods utilized to create the simulated conditions and the time periods allotted to each.

.8 Performance Tests:

.1 Performance tests shall be conducted either concurrently with or subsequent to the running test, as practicable and agreed between the Contract Administrator, the Manufacturer's Representative, and the Construction Contractor.

.2 The equipment shall be run continuously for a minimum of seven (7) days (one hundred sixty-eight (168) hours) or as specified.

.3 Performance tests shall be as dictated in the technical specifications for each item of equipment or as reasonably required by the Contract Administrator to prove adherence to the requirements listed in the Specification.

.4 The Construction Contractor shall submit the results of the performance tests within twenty-four (24) hours to the Contract Administrator, and final documented and summarized results in a format acceptable to the Contract Administrator within seven (7) calendar days. The Contract Administrator reserves the right to request additional testing. No equipment shall be accepted and handed over to the City prior to the satisfactory completion of the performance test(s) and receipt of the test reports.

.9 The Construction Contractor shall supply all water, chemicals, temporary power, heating, and/or any other ancillary equipment or services required to complete the initial demonstration, running test and performance tests.

.10 Should the initial demonstration, running test or performance tests reveal any defects, then those defects shall be promptly rectified and the demonstration, running tests, and/or performance tests shall be repeated to the satisfaction of the Contract Administrator. Additional costs incurred by the Construction Contractor, or the Contract Administrator, due to repeat demonstration, running tests, and/or performance tests shall be the responsibility of the Construction Contractor.

.11 Forms 103 and 104 are provided in 01 91 31 Commissioning Plan.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

CERTIFICATE OF EQUIPMENT DELIVERY
FORM 100

We certify that the equipment listed below has been received and delivered into the care of the Construction Contractor. The equipment has been found to be in satisfactory condition. No defects in the equipment were found.

PROJECT: _____

ITEM OF EQUIPMENT: _____

_____

TAG NO: _____

REFERENCE SPECIFICATION: _____

_____ _____
(Authorized Signing Representative of the Construction Contractor) Date

_____ _____
(Authorized Signing Representative of the Manufacturer) Date

_____ _____
(Authorized Signing Representative of the Contract Administrator) Date

CERTIFICATE OF READINESS TO INSTALL
FORM 101

I have familiarized the Construction Contractor of the specific installation requirements related to the equipment listed below and am satisfied that he understands the required procedures.

PROJECT: _____

ITEM OF EQUIPMENT: _____

_____

TAG NO: _____

REFERENCE SPECIFICATION: _____

_____ _____
(Authorized Signing Representative of the Manufacturer) Date

I certify that I have received satisfactory installation instructions from the equipment Manufacturer/ Supplier.

_____ _____
(Authorized Signing Representative of the Construction Contractor) Date

CERTIFICATE OF SATISFACTORY INSTALLATION
FORM 102

I have completed my check and inspection of the installation listed below and confirm that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

PROJECT: _____

ITEM OF EQUIPMENT: _____

_____

TAG NO: _____

REFERENCE SPECIFICATION: _____

OUTSTANDING DEFECTS: _____

_____ _____
(Authorized Signing Representative of the Manufacturer) Date

_____ _____
(Authorized Signing Representative of the Construction Contractor) Date

_____ _____
(Authorized Signing Representative of the Contract Administrator) Date

INSTALLATION OF PRE-PURCHASED EQUIPMENT

1. GENERAL

1.1 Work Included

.1 This Section specifies the delivery, installation, testing and commissioning of the Dewatering Rotary Press and Polymer Dosing Systems as shown on the Drawings and specified herein.

.2 The Dewatering Rotary Press and Polymer Dosing Systems have been pre-purchased by the City via separate Contract. (Hereafter referred to as the Supply of Rotary Press and Appurtenances Contract).

.3 Supply of Rotary Press and Appurtenances Contract includes all equipment and appurtenances as listed in the Equipment Supply Contractor's Equipment List (see Appendix C). It is the Construction Contractor's responsibility to familiarize themselves with the Rotary Press and Appurtenances Supply Contract and contact the Rotary Press and Appurtenances Supply Contractor to request clarification where required.

.4 Responsibilities of the Construction Contractor include, but are not limited to:

.1 Coordinating receipt of the pre-purchased equipment upon delivery.

.2 Off-loading and storage of all equipment.

.3 Coordinate installation training for the equipment.

.4 Install all equipment and materials provided under the Rotary Press and Appurtenances Equipment Supply Contracts, in accordance with the instructions provided by the Rotary Press and Appurtenances Equipment supplier and as specified.

.5 Construction Contractor is responsible to position all components of the pre-purchased equipment on Site.

.6 Supply and installation of all external piping, pumps and valves between pre-purchased equipment/skid packages and other equipment.

.7 Supply and install of all electrical wiring and electrical conduit for pre-purchased equipment.

.8 Supply and install data communication cable from the plant Supervisory Control and Data Acquisition (SCADA) system to the process PLC control system.

.9 Conduct testing, performance verification and commissioning of the equipment, in cooperation with the Rotary Press and Appurtenances Equipment Supply Contractor.

.10 Supply and install all anchor bolts for equipment.

.11 Construction of concrete housekeeping pads for all equipment.

.12 The Construction Contractor is required to provide and install all cabling, piping, valves etc. not provided by the pre-purchased equipment, as shown in the drawings and specifications.

.13 The Construction Contractor is required to provide and install all interconnection pipe and cabling required to connect all pre-purchased equipment supplied skid mounted equipment.

.14 Coordinate operation and maintenance training for the equipment.

.15 Coordinate operation and maintenance material from pre-purchased equipment for inclusion in the project O&M Manuals.

.16 Authorizing signing representative of the Construction Contractor must sign off on Forms 100, 101, 102, and 103 (Section 01 65 00) for all pre-purchased equipment.

1.2 Coordination

.1 Coordinate with other Divisions to ensure that there is no conflict with the Work.

2. PRODUCTS (NOT USED)

3. EXECUTION

3.1 Manufacturer's Representative

.1 The Rotary Press and Appurtenances Equipment Supply Contractor will provide a technically qualified Manufacturer's Representative as per the Contract. Arrange for the Manufacturer's Representative to:

.1 Certify equipment delivery.

.2 Provide installation training.

.3 Certify acceptable equipment installation.

.4 Attend and certify equipment performance testing.

.5 Provide O&M manuals and operator training.

3.2 Delivery, Protection, and Storage

.1 Pre-purchased equipment will be delivered to and stored at a location identified by the Construction Contractor. The Construction Contractor shall offload and accept equipment delivery. The cost for storage, pick-up and delivery of equipment from the Construction Contractor's storage location to the jobsite will be borne by the Construction Contractor.

.2 Construction Contractor to provide suitable storage for all pre-purchased equipment. Note electrical equipment, including all PLC's, may require climate controlled rooms to prevent overheating or freezing of sensitive electronic components.

.1 Pre-purchased equipment must be stored in a sheltered area, protected from freezing, direct sunlight or extreme heat and sealed as shipped until ready for use. Storage should be in a dark, dry, level area out of direct sunlight and at a temperature of 5-30°C.

.3 The Construction Contractor shall be responsible for the security and safekeeping all equipment at the jobsite.

.4 The Construction Contractor shall ensure that they are fully informed of precautions to be taken in the unloading of equipment and its subsequent storage including any required maintenance.

.5 All forms referred to in this Section (Forms 100, 101, 102 and 103) will be completed by the Rotary Press and Appurtenances Equipment Supply Contractor and the Construction Contractor as detailed below.

.6 Prior to accepting any of the pre-purchased equipment, the Construction Contractor shall inspect the equipment. A representative from each of the following groups will be in attendance at the time of pick-up and delivery: the Supply Contractor, Construction Contractor, and Contract Administrator. A duly executed Form 100 – Certificate of Equipment Delivery shall be completed. Any minor damage identified during the inspection shall be repaired as per the Rotary Press and Appurtenances Equipment Supply Contractor's instructions at the Supply Contractor's cost. Any severe damage will be grounds for rejection of the equipment. The severely damaged equipment will be replaced at the Rotary Press and Appurtenances Equipment Supply Contractor's cost. The Construction Contractor shall accept the pre-purchased equipment and assume risk and responsibility for the equipment and fill out Form 100 - Certificate of Equipment Delivery.

.7 If the Rotary Press and Appurtenances Equipment Supply Contractor's inspection reveals any deficiencies in the equipment, then these shall be noted in writing prior to the Construction Contractor accepting the equipment. Only deficiencies noted and documented in the foregoing manner will be deemed not the responsibility of the Construction Contractor.

.8 The Construction Contractor shall be responsible for the installation of pre-purchased equipment in addition to all equipment supplied under this Construction Contract.

.9 For the purposes of Form 100, the Rotary Press and Appurtenances Equipment Supply Contractor will be the Manufacturer.

3.3 Installation

.1 The Rotary Press and Appurtenances Equipment Supply Contractor will provide the services of a qualified representative to assist in the installation, start-up, and performance testing of all of the equipment. The Construction Contractor shall refer to Sections 01 65 00 – Equipment Installation, for details on the services and procedures not included in this Section. The services to be performed by the Rotary Press and Appurtenances Equipment Supply Contractors are as follows:

.1 Prior to the Construction Contractor beginning the installation, the Pre-purchased Equipment Supply Contractor will provide to the Construction Contractor instructions and advice regarding the detailed requirements for the equipment installation. The Rotary Press and Appurtenances Equipment Supply Contractor will be required to provide a Certificate of Readiness to Install, Form 101. The Construction Contractor shall be required to sign Form 101 to acknowledge that he has received adequate instruction. During installation, if the Construction Contractor has additional questions regarding installation requirements or procedures, he shall contact the Rotary Press and Appurtenances Equipment Supply Contractor, with the assistance of the Contract

Administrator, as required. No additional compensation to the Construction Contractor based on claims of inadequate training from a Rotary Press and Appurtenances Equipment Supply Contractor will be entertained should he install equipment improperly.

.2 Following the completion of the installation, the Rotary Press and Appurtenances Equipment Supply Contractor will inspect the installation of the equipment to verify that it has been installed in accordance with the Rotary Press and Appurtenances Equipment Supply Contractor's requirements. The Rotary Press and Appurtenances Equipment Supply Contractor will be required to provide a Certificate of Satisfactory Installation, Form 102. If any deficiencies in the installation exist at the time of inspection, these shall be noted on Form 102 by the Rotary Press and Appurtenances Equipment Supply Contractor. The Construction Contractor shall be responsible for the prompt correction of these deficiencies prior to performance testing of the equipment.

.3 The Rotary Press and Appurtenances Equipment Supply Contractor shall assist the Construction Contractor in Performance Verification of the equipment.

.4 The Rotary Press and Appurtenances Equipment Supply Contractor shall provide site visits for inspection of installation and for assistance of Performance Verification as per the Contract.

3.4 Commissioning and Process Performance Testing

.1 Refer to Section 01 91 13 for all general commissioning requirements.

.2 The Construction Contractor is responsible for Commissioning of the Rotary Press and Appurtenances systems which includes the pre-purchased equipment, CIP skid, pump skids, and all other equipment specified in this Section and to ensure the equipment functions as intended in the process systems.

.3 Inform the Contract Administrator at least fourteen (14) days in advance of conducting the tests. The tests may be concurrent with the inspection of satisfactory installation if mutually agreed by the Construction Contractor and the Contract Administrator.

.4 The Rotary Press and Appurtenances Equipment Supply Contractor will conduct all necessary checks to equipment as per the Contract and if necessary, advise the Construction Contractor of any further checking, flushing, cleaning, or other work needed prior to confirming the equipment is ready to run.

.5 The Construction Contractor shall then operate the equipment for at least one (1) hour to demonstrate the operation of the equipment and any required ancillary services. Any remedial measures required to ensure satisfactory operation shall be promptly undertaken.

.6 Demonstration:

.1 The Construction Contractor shall notify the Contract Administrator of his readiness to demonstrate the operation of the equipment. The Contract Administrator shall attend, as expeditiously as possible.

.2 With the assistance of the Rotary Press and Appurtenances Equipment Supply Contractor, the Construction Contractor shall demonstrate that the equipment is

properly installed. Alignment, piping connections, electrical connections, etc. will be checked and if appropriate, code certifications provided.

.3 The equipment shall then be run for one (1) hour. Local controls shall be satisfactorily verified by cycling the equipment through several start-stop operations, modulating its output, or some combination. Operating parameters such as temperature, pressure, voltage, vibration, etc., will be checked to ensure that they are within the specified or Supply Contractor's recommended limits, whichever is more stringent.

.4 On satisfactory completion of the one (1) hour demonstration, the equipment shall be stopped and critical parameters, such as alignment, shall be rechecked.

.7 Running Test:

.1 The equipment shall be restarted and run continuously for a minimum of three (3) days (72 hours) or as specified. During this period, as practicable, conditions shall be simulated which represent maximum or most severe, average, and minimum or least severe conditions. These conditions will be mutually agreed by the Supply Contractor, the Construction Contractor, and Contract Administrator on the basis of the information contained in the technical specifications, as well as the methods utilized to create the simulated conditions and the time periods allotted to each.

.8 Performance Tests:

.1 Performance tests shall be conducted either concurrent with or subsequent to the running test, as practicable and agreed between the Contract Administrator, the Supply Contractor, and the Construction Contractor.

.2 The equipment shall be run continuously for a minimum of fourteen (14) days or as specified.

.3 Performance tests shall be as dictated in the technical specifications for each item of equipment or as reasonably required by the Contract Administrator to prove adherence to the requirements listed in the specification.

.4 The Construction Contractor shall submit the results of the performance tests within twenty four (24) hours to the Contract Administrator, and final documented and summarized results in a format acceptable to the Contract Administrator within seven (7) calendar days. The Contract Administrator reserves the right to request additional testing. No equipment shall be accepted and handed over to the City prior to the satisfactory completion of the performance test(s) and receipt of the test reports.

.9 All water, chemicals, temporary power (except portable generators), heating, or any other ancillary services required to complete the initial demonstration, running test and performance tests are the responsibility of the Construction Contractor.

.10 Should the initial demonstration, running test or performance tests reveal any defects, then those defects shall be promptly rectified and the demonstration, running tests, and / or performance tests shall be repeated to the satisfaction of the Contract Administrator. Additional costs incurred by the Construction Contractor, the Contract Administrator, or the City, due to repeat demonstration, running tests, and/or performance tests shall be the responsibility of the Construction Contractor or Supply Contractor as determined by the Contract Administrator.

.11 On successful completion of the demonstration, running test, and performance tests, Form 103 – Certificate of Equipment Satisfactory Performance attached to Section 01 65 00 – Equipment Installation will be signed by the Supply Contractor, the Construction Contractor, and the Contract Administrator.

.12 Cooperate with the Rotary Press and Appurtenances Equipment Supplier to fulfill the requirements for successful testing of the equipment. Execute Form 103 - Certificate of Satisfactory Equipment Testing.

.13 The Construction Contractor is responsible to complete the Process Performance Testing of all equipment, which includes the equipment specified in this Section, and to ensure the equipment functions as intended. The Rotary Press and Appurtenances Equipment Supplier is responsible to provide all testing instructions, oversee performance testing and is responsible for the overall performance of the treatment system.

.14 Cooperate with the Rotary Press and Appurtenances Equipment Supplier to fulfill the requirements for successful process performance testing of the equipment. Execute Form 104 - Certificate of Satisfactory Process Performance.

3.5 Training

.1 Arrange and coordinate the O&M training included in the scope of services specified in the Rotary Press and Appurtenances Equipment Supply Contract.

END OF SECTION

1. GENERAL

1.1 References

.1 The Contract Administrator's identification of existing survey control points and property limits.

1.2 Qualifications of Surveyor

.1 Qualified registered land surveyor, licensed to practice in Manitoba, acceptable to Contract Administrator.

1.3 Survey Reference Points

.1 Existing base horizontal and vertical control points are designated on the Drawings.

.2 Locate, confirm and protect control points prior to starting Site Work. Preserve permanent reference points during construction.

.3 Make no changes or relocations without prior written notice to the Contract Administrator.

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

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

1.4 Survey Requirements

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

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

.3 Stake for grading, fill and topsoil placement and landscaping features.

.4 Stake slopes and berms.

.5 Establish pipe invert, catch basin and manhole 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.

1.5 Existing Services

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

.2 Remove abandoned service lines within 2 m of structures. Cap or otherwise seal lines at cut-off points as directed by the Contract Administrator at no cost to the City.

1.6 Location of Equipment and Fixtures

.1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.

.2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with the Manufacturer's Recommendations for safety, access and maintenance.

.3 Inform the Contract Administrator of impending installation and obtain approval for actual location.

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

1.7 Records

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

.2 On completion of foundations and major Site improvements, prepare a certified survey showing dimensions, locations, angles and elevations of the Work.

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

1.8 Action and Informational Submittals

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

.2 On request of the Contract Administrator, submit documentation to verify accuracy of the field engineering Work.

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

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

EXECUTION

1. GENERAL

1.1 Action and Informational Submittals

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

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

.1 Structural integrity of elements of project.

.2 Integrity of weather-exposed or moisture-resistant elements.

.3 Efficiency, maintenance, or safety of operational elements.

.4 Visual qualities of sight-exposed elements.

.5 Work of the City, Contract Administrator, or separate contractor.

.6 Include in request:

.1 Identification of project.

.2 Location and description of affected Work.

.3 Statement on necessity for cutting or alteration.

.4 Description of proposed Work, and products to be used.

.5 Alternatives to cutting and patching.

.6 Effect on Work of the City, Contract Administrator, or separate contractor.

.7 Written permission of affected separate contractor.

.8 Date and time work will be executed.

1.2 Materials

.1 Required for original installation.

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

1.3 Preparation

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

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

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

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

.5 Provide protection from elements for areas that are to be exposed by uncovering work; maintain excavations free of water.

1.4 Execution

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

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

.3 Uncover Work to install ill-timed Work.

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

.5 Remove samples of installed Work for testing.

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

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

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

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

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

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

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

.13 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.

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

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

CLEANING

1. GENERAL

1.1 Project Cleanliness

.1 Maintain Work in tidy condition, free from accumulation of waste products and debris, including that caused by the Contract Administrator or other Construction Contractors.

.2 Remove waste materials from the Site at weekly regularly scheduled times or dispose of as directed by the Contract Administrator or the City. Do not burn waste materials on Site.

.3 Clear snow and ice from access to Site.

.4 Make arrangements with and obtain permits from Authorities Having Jurisdiction for disposal of waste and debris.

.5 Provide on-site containers for collection of waste materials and debris.

.6 Provide and use marked separate bins for recycling. Refer to Section 01 74 19 - Construction Waste Management Disposal.

.7 Dispose of waste materials and debris at designated dumping areas off Site.

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

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

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

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

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

1.2 Final Cleaning

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

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

.3 Prior to final review remove surplus products, tools, construction machinery and equipment.

.4 Remove waste materials from the Site at regularly scheduled times or dispose of as directed by the Contract Administrator. 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 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.

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

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

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

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

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

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

.13 Remove dirt and other disfiguration from exterior surfaces.

.14 Clean and sweep roofs, gutters, areaways, and sunken wells.

.15 Sweep and wash clean paved areas.

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

.17 Clean roofs, downspouts, and drainage systems.

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

.19 Remove snow and ice from access to building.

1.3 Waste Management and Disposal

.1 Separate waste materials for recycling in accordance with Section 01 74 19 - Construction Waste Management and Disposal.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

CONSTRUCTION WASTE MANAGEMENT DISPOSAL

1. GENERAL

1.1 Waste Management Goals

.1 Accomplish maximum control of solid construction waste.

.2 Preserve environment and prevent pollution and environment damage.

1.2 Definitions

.1 Class III: non-hazardous waste - construction renovation and demolition waste.

.2 Materials Source Separation Program (MSSP): consists of series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.

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

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

.5 Recycling: process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

.6 Separate Condition: refers to waste stored into individual types.

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

1.3 Documents

.1 Maintain at job site, one (1) copy of following documents:

.1 Material Source Separation Plan.

1.4 Action and Informational Submittals

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

.2 Prepare and submit following prior to project start-up:

.1 Submit two (2) copies of Materials Source Separation Program (MSSP) description.

1.5 Materials Source Separation Program (MSSP)

.1 Prepare MSSP and have ready for use prior to project start-up.

.2 Implement MSSP for waste generated on project in compliance with approved methods and as reviewed by Contract Administrator.

.3 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and recyclable materials.

.4 Provide containers to deposit reusable and recyclable materials.

.5 Locate containers in locations, to facilitate deposit of materials without hindering daily operations.

.6 Locate separated material(s) in area(s) which minimize material damage.

.7 Collect, handle, store on-site, and transport off-site, salvaged materials in separate condition.

.1 Transport to approved and authorized recycling facility.

.8 Collect, handle, store on-site, and transport off-site, salvaged materials in combined condition.

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

.2 Materials must be immediately separated into required categories for reuse or recycling.

1.6 Storage, Handling and Protection

.1 Store, materials to be reused, recycled and salvaged in locations as directed by Contract Administrator.

.2 Unless specified otherwise, materials for removal do not become Construction Contractor's property.

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

.4 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.

.5 Protect surface drainage, mechanical and electrical from damage and blockage.

.6 Separate and store materials produced during dismantling of structures in designated areas.

.7 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.

.1 On-site source separation is recommended.

.2 Remove co-mingled materials to off-site processing facility for separation.

.3 Provide waybills for separated materials.

1.7 Disposal of Wastes

.1 Do not bury rubbish or waste materials.

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

1.8 Use of Site and Facilities

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

.2 Provide temporary security measures approved by Contract Administrator.

1.9 Scheduling

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

2. PRODUCTS (NOT USED)

3. EXECUTION

3.1 Application

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

3.2 Cleaning

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

.2 Clean-up work area as work progresses.

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

3.3 Diversion of Materials

.1 The diversion of waste material from landfills is highly encourages. Separate recyclable and reusable materials where possible.

.2 On-site sale of salvaged, recovered, reusable, or recyclable material is not permitted.

3.4 Canadian Governmental Departments Chief Responsibility for the Environment

.1 Manitoba Sustainable Development:

Province	Address	General Inquiries
Manitoba	Province of Manitoba Conservation and Water Stewardship Box 22 - 200 Saulteaux Crescent Winnipeg, MB R3J 3W3	204-945-6784

3.5 Cost of Disposal

.1 Construction Contractor to pay all solid waste disposal tipping fees for waste disposed of.

END OF SECTION

CLOSEOUT SUBMITTALS

1. GENERAL

1.1 Submittals

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

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

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

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

.5 Four (4) weeks prior to Substantial Performance of the Work, submit to the Contract Administrator six (6) final paper copies of the Operating and Maintenance (O&M) Manuals and one (1) electronic copy (PDF) on USB drive in S.I. Units.

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

.7 Furnish evidence, if requested, for type, source and quality of the products provided.

.8 Defective products will be rejected, regardless of previous inspections.

1.2 Format

.1 Organize data as an instructional manual.

.2 Binders shall be vinyl, hard covered, 3 'D' ring, loose leaf with spine and face pockets. The maximum width of each binder shall not exceed 125 mm; where there is more data than will fit in a binder of 125 mm maximum width, the number of binders shall be as required.

.3 When multiple binders are used, correlate the data into related consistent groupings. Identify contents of each binder on the spine.

.4 Covers shall be used to identify each binder with type or printed title "Operation and Maintenance Manual"; list date, title of project, City of Winnipeg, Construction Contractor and Contract Administrator, and identify subject matter of contents.

.5 Arrange content by systems, under Section numbers and sequence of Table of Contents.

.6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.

.7 The text shall be manufacturer's printed data, or typewritten data.

.8 Drawings shall be provided with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

.9 Provide 1:1 scaled CAD files in dwg format on a USB drive.

.10 Provide one (1) electronic copy (on USB drive) of the entire manual. The electronic copy shall have a linked Table of Contents to each section and shall be word searchable.

1.3 Contents - Each Volume

.1 Table of Contents: provide title of project:

.1 Date of submission; names.

.2 Addresses and telephone numbers of the Contract Administrator and Construction Contractor with the names of responsible parties.

.3 Schedule of products and systems, indexed to content of volume.

.2 For each product or system:

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

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

.4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Drawings larger than 210 mm x 300 mm (A4) shall be contained in plastic pouch. Provide a separate panel for each drawing.

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

.6 Training: refer to Section 01 79 00 - Demonstration and Training.

1.4 As-Builts and Samples

.1 Maintain, in addition to the requirements in the General Conditions, at Site for Contract Administrator one (1) record copy of:

.1 Construction Contract Drawings.

.2 Field test records.

.3 Inspection certificates.

.4 Manufacturer's certificates.

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

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

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

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

1.5 Recording Actual Site Conditions

.1 Record information on set of Issued for Construction drawings.

.2 Provide felt tip marking pens, maintaining separate colours for each major system, for recording information.

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

.4 Construction Contract Drawings and Shop Drawings: mark each item to record actual construction, including:

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

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

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

.4 Field changes of dimension and detail.

.5 Changes made by change orders.

.6 Details not on original Construction Contract Drawings.

.7 References to related Shop Drawings and modifications.

.5 Specifications: mark each item to record actual construction, including:

.1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.

.2 Changes made by Addenda and change orders.

.6 Other Documents: maintain manufacturer's certifications, inspection certifications, and field test records as required by individual Specifications Sections.

1.6 Final Survey

.1 Submit final Site survey certificate in accordance with Section 01 71 00 - Examination and Preparation, certifying that elevations and locations of completed Work are in conformance, or non-conformance with the Construction Contract Documents.

1.7 Equipment and Systems

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

.2 Provide copy of reviewed submittals.

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

.4 Include installed colour coded wiring diagrams.

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

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

.7 Provide a servicing and lubrication schedule, and a list of lubricants required.

.8 Include Manufacturer's printed O&M instructions.

.9 Include the sequence of operation by the controls Manufacturer.

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

.11 Provide installed control diagrams by the controls Manufacturer.

.12 Provide the Construction Contractor's co-ordination drawings, with installed colour coded piping diagrams.

.13 Provide charts of valve tag numbers, with the location and function of each valve, keyed to flow and control diagrams.

.14 Provide a list of original Manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

.15 Include test and balancing reports as specified in Section 01 45 00 - Quality Control and Section 01 91 31 - Commissioning Plan.

.16 Additional requirements: as specified in individual Specification Sections.

1.8 Materials and Finishes

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

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

.3 Moisture-Protection and Weather-Exposed Products: include the Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.4 Additional Requirements: as specified in individual Specifications Sections.

1.9 Spare Parts

.1 Provide spare parts, in quantities specified in individual Specification Sections.

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

.3 Deliver to Site; place and store.

.4 Receive and catalogue items. Submit inventory listing to the Contract Administrator. Include approved listings in O&M Manual.

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

1.10 Maintenance Materials

.1 Provide maintenance and extra materials, in quantities specified in the individual Specification Sections.

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

.3 Deliver to site; place and store.

.4 Receive and catalogue items. Submit inventory listing to the Contract Administrator. Include approved listings in the O&M Manual.

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

1.11 Special Tools

.1 Provide special tools, in quantities specified in individual Specification Section.

.2 Provide items with tags identifying their associated function and equipment.

.3 Deliver to site; place and store.

.4 Receive and catalogue items. Submit inventory listing to the Contract Administrator. Include approved listings in the O&M Manual.

1.12 Storage, Handling and Protection

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

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

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

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

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

1.13 Warranties and Bonds

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

.2 Submit warranty management plan, thirty (30) days before planned pre-warranty conference, to Contract Administrator approval.

.3 Warranty management plan to include required actions and documents to assure that the Contract Administrator receives warranties to which it is entitled.

.4 Provide the plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.

.5 Submit warranty information made available during the construction phase, to the Contract Administrator for approval prior to each monthly pay estimate.

.6 Assemble approved information in binder and submit upon acceptance of work. Organize the binder as follows:

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

.2 List Subcontractor, Supplier, and Manufacturer, with name, address, and telephone number of responsible principals.

.3 Obtain warranties and bonds, executed in duplicate by Subcontractors, Suppliers, and Manufacturers, within ten (10) days after completion of the applicable item of Work.

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

.5 Co-execute submittals when required.

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

.7 Conduct a joint ten (10) month warranty inspection, measured from Substantial Completion, by the Contract Administrator.

.8 Include information contained in the warranty management plan as follows:

.1 Roles and responsibilities of personnel associated with the warranty process, including points of contact and telephone numbers within the organizations of Construction Contractors, Subcontractors, Manufacturers or Suppliers involved.

.2 Provide a list for each warranted equipment, item, feature of construction or system indicating:

.1 Name of item.

.2 Model and serial numbers.

.3 Location where installed.

.4 Name and phone numbers of Manufacturers or Suppliers.

.5 Names, addresses and telephone numbers of sources of spare parts.

.6 Warranties and terms of warranty: include one (1) year overall warranty of construction from Substantial Completion. Indicate items that have extended warranties and show separate warranty expiration dates.

.7 Cross-reference to warranty certificates as applicable.

.8 Starting point and duration of the warranty period.

.9 Summary of maintenance procedures required to continue warranty in force.

.10 Cross-Reference to specific pertinent O&M Manuals.

.11 Organization, names and phone numbers of persons to call for warranty service.

.12 Typical response time and repair time expected for various warranted equipment.

.3 Procedure and status of tagging equipment covered by extended warranties.

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

.9 Respond within seventy-two (72) hours to oral or written notification of required construction warranty repair work.

.10 Written verification will follow oral instructions. Failure to respond will be cause for the City to proceed with action against the Construction Contractor.

1.14 Pre-Warranty Conference

.1 Meet with the Contract Administrator, to develop an understanding of the requirements of this Section. Schedule a meeting prior to Construction Contract completion, and at time designated by the Contract Administrator.

.2 The Contract Administrator will establish communication procedures for:

.1 Notification of construction warranty defects.

.2 Determine priorities for type of defect.

.3 Determine reasonable time for response.

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

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

1.15 Warranty Tags

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

.2 Attach tags with a durable plastic tie.

.3 Leave the date of acceptance until project is accepted for occupancy.

.4 Indicate the following information on the tag:

.1 Type of product/material.

.2 Model number.

.3 Serial number.

.4 Construction Contract number.

.5 Warranty period.

.6 Inspector's signature.

.7 Construction Contractor.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

OPERATION AND MAINTENANCE DATA

1. GENERAL

1.1 Section Includes

.1 Detailed information for the preparation, submission, and Contract Administrator's review of operations and maintenance (O&M) data, as required by individual Specification sections.

1.2 Definitions

.1 Preliminary Data: Initial and subsequent submissions for Contract Administrator's review.

.2 Final Data: Contract Administrator-accepted data, submitted as specified herein.

.3 Maintenance Operation: As used on Maintenance Summary Form is defined to mean any routine operation required to ensure satisfactory performance and longevity of equipment. Examples of typical maintenance operations include but are not limited to lubrication, belt tensioning, adjustment of pump packing glands, and routine adjustments.

.4 Instructional Manual: An organized compilation of operating and maintenance data including detailed technical information, documents and records describing operation and maintenance of individual systems, subsystems and components as specified in individual sections of this specification.

1.3 Sequencing and Scheduling

.1 Equipment and System Data:

.1 Preliminary Data:

.1 Do not submit until Shop Drawing for equipment or system has been reviewed and returned stamped "NO EXCEPTIONS TAKEN" or "EXCEPTIONS NOTED" by Contract Administrator.

.2 Submit prior to shipment date.

.2 Final Data:

.1 Submit Instructional Manual not less than thirty (30) days prior to equipment or system field Functional Testing.

.2 Submit Compilation Formatted and Electronic Media Formatted data prior to Substantial Performance of Project.

.3 Final accepted O&M Manuals are a required prior to Substantial Completion being granted.

1.4 Data Format

.1 Preliminary Manual Format:

.1 Binder: Commercial quality, permanent, three-ring binders with durable plastic cover.

.1 Three hole punch data for binding and composition; arrange printing so that punched holes do not obliterate data.

.2 Size: 8-1/2 inches by 11 inches, minimum.

.3 Cover: Identify manual with typed or printed title “OPERATION AND MAINTENANCE DATA, VOLUME NO._OF____”,” and list:

.1 Project title.

.2 Contractor’s name, address, and telephone number.

.3 If entire volume covers equipment or system provided by one supplier include the following:

.1 Identity of general subject matter covered in manual.

.2 Identity of equipment number and Specification section.

.4 Provide each volume with title page and typed table of contents with consecutive page numbers. Place contents of entire set, identified by volume number, in each binder.

.5 Table of contents neatly typewritten, arranged in a systematic order:

.1 Include list of each product, indexed to content of each volume.

.2 Designate system or equipment for which it is intended.

.3 Identify each product by product name and other identifying numbers or symbols as set forth in Contract Documents.

.6 Section Dividers:

.1 Heavy, 80 pound cover weight, tabbed with numbered plastic index tabs.

.2 Fly-Leaf:

.1 For each separate product, or each piece of operating equipment, with typed description of product and major component parts of equipment.

.2 List with each product:

.1 Name, address, and telephone number of Subcontractor, supplier, installer, and maintenance contractor, as appropriate.

.2 Identify area of responsibility of each.

.3 Provide local source of supply for parts and replacement.

.3 Identity of separate structure as applicable.

.4 Maintenance Summary (Format in accordance with paragraph 1.6.4)

.7 Assemble and bind material in same order as specified in the Contract Documents.

.8 Material shall be suitable for reproduction, with quality equal to original.

.2 Final Instructional Manual Format:

.1 Compile all Contract Administrator-accepted preliminary O&M data into a hard-copy, hard-bound set as detailed in Section 1.2.1 above and in electronic media format as described in paragraph 1.4.3.

.3 Electronic Media Format:

.1 Portable Document Format (PDF):

.1 After all preliminary data has been found to be acceptable to Contract Administrator, upload electronic copies of O&M data to the City's DMS (Aconex) in PDF format and in native file format as applicable

.2 Files to be exact duplicates of Contract Administrator-accepted preliminary data. Arrange by specification number and name.

.3 Files to be fully functional and viewable in most recent version of Adobe Acrobat.

.4 PDF files to be indexed and searchable.

.5 CD Cover: Identify with typed or printed title "OPERATION AND MAINTENANCE DATA, VOLUME NO.____OF____"," and list:

.1 Project title.

.2 Contractor's name, address, and telephone number.

.3 Identity of equipment number and Specification section.

1.5 Submittals

.1 Informational:

.1 Data Outline: Submit an electronic copy of a detailed outline of proposed organization and contents of final data prior to preparation of preliminary data.

.2 Preliminary Data:

.1 Submit three (3) hard copies for Contract Administrator's review.

.2 If data meets conditions of the Contract:

.1 One (1) copy will be returned to Contractor.

.2 One (1) copy will be forwarded to The City.

.3 One (1) copy will be retained in Contract Administrator's file.

.3 If data does not meet conditions of the Contract:

.1 Two (2) copies will be returned to Contractor with Contract Administrator's comments (on separate document) for revision.

.2 One (1) copy with comments will be retained in Contract Administrator's file.

.3 Resubmit three (3) copies revised in accordance with Contract Administrator's comments.

.3 Final Data: Submit six (6) hard copies in format(s) specified herein. No red lines on the documents are allowed in final submission.

1.6 Data For Systems, Subsystem and Components

.1 Content For Each Unit (or Common Units) and System unless otherwise specified:

.1 Product Data:

.1 Include only those sheets that are pertinent to specific product.

.2 Clearly annotate each sheet to:

.1 Identify specific product(s) or part(s) installed.

.2 Identify data applicable to installation.

.3 Delete references to inapplicable information.

.3 Function, normal operating characteristics, and limiting conditions.

.4 Serial Numbers

.5 Performance curves, engineering data, nameplate data, and tests reports for all pumps.

.6 Complete nomenclature and commercial number of replaceable parts.

.7 Original manufacturer's parts list, illustrations, detailed assembly drawings showing each part with part numbers and sequentially numbered parts list, and diagrams required for maintenance.

.8 Spare parts ordering instructions.

.9 Where applicable, identify installed spares and other provisions for future work (e.g., reserved panel space, unused components, wiring, terminals).

.2 As-installed, color-coded piping diagrams.

.3 Charts of valve tag numbers, with the location and function of each valve.

.4 Drawings: Supplement product data with Drawings as necessary to clearly illustrate:

.1 Format:

.1 Provide reinforced, punched, binder tab; bind in with text.

.2 Reduced to 8-1/2 inches by 11 inches, or 11 inches by 17 inches folded to 8-1/2 inches by 11 inches.

.3 Where reduction is impractical, fold and place in 8-1/2-inch by 11-inch envelopes bound in text.

.4 Identify Specification section and product on Drawings and envelopes.

.2 Relations of component parts of equipment and systems.

.3 Control and flow diagrams.

.4 Coordinate drawings with Project record documents to assure correct illustration of completed installation.

.5 Instructions and Procedures: Within text, as required to supplement product data.

.1 Format:

.1 Organize in consistent format under separate heading for each different procedure.

.2 Provide logical sequence of instructions for each procedure.

.3 Provide information sheet for The City's personnel, including:

.1 Proper procedures in event of failure.

.2 Instances that might affect validity of guarantee or Bond.

.2 Installation Instructions: Including alignment, adjusting, calibrating, and checking.

.3 Operating Procedures:

.1 Startup, break-in, routine, and normal operating instructions.

.2 Test procedures and results of factory tests where specified.

.3 Regulation, control, stopping, and emergency instructions.

.4 Description of operation sequence by control manufacturer.

.5 Shutdown instructions for both short and extended duration.

.6 Summer and winter operating instructions, as applicable.

.7 Safety precautions.

.8 Special operating instructions.

.4 Maintenance and Overhaul Procedures:

.1 Routine maintenance.

.2 Guide to troubleshooting.

.3 Disassembly, removal, repair, reinstallation, and re-assembly.

.6 Guarantee, Bond, and Service Agreement: In accordance with Section 01 78 00, Closeout Procedures.

.2 Content for Each Electric or Electronic Item or System:

.1 Description of Unit and Component Parts:

.1 Function, normal operating characteristics, and limiting conditions.

.2 Performance curves, engineering data, nameplate data, and tests.

.3 Complete nomenclature and commercial number of replaceable parts.

.4 Interconnection wiring diagrams, including control and lighting systems.

.2 Circuit Directories of Panelboards:

.1 Electrical service.

.2 Controls.

.3 Communications.

.3 List of electrical relay settings, and control and alarm contact settings.

.4 Electrical interconnection wiring diagram, including control and lighting systems.

.5 As-installed control diagrams by control manufacturer.

.6 ISA S20 data sheets for all instruments.

.7 Operating Procedures:

.1 Routine and normal operating instructions.

.2 Sequences required.

.3 Safety precautions.

.4 Special operating instructions.

.8 Maintenance Procedures:

.1 Routine maintenance.

.2 Guide to troubleshooting.

.3 Adjustment and checking.

.4 List of relay settings, control and alarm contact settings.

.9 Manufacturer's printed operating and maintenance instructions.

.10 List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.

.3 Content for Programmable Devices/Components/Sub-systems:

.1 The following requirements are minimum requirements applicable to programmable equipment such as VFDs, ASDs, microprocessor based devices, PLCs, Human-Machine- Interfaces, computers, and other programmable devices. Additional requirements may be specified elsewhere.

.2 As-Constructed version of shop drawings.

.3 Functional description.

.4 Wiring details.

.5 Configuration Records; record of switch settings, program listings and parameter settings, after commissioning.

.6 Maintenance manuals.

.7 User guides, technical reference and programming manuals.

.8 CD-ROMs copies of:

.1 Manuals.

.2 Settings, databases and templates. Include both native format of files and ASCII-exported version.

.3 Application programs.

.9 Cable and software for use on The City's notebook computer for revising/downloading the settings and software.

.4 Maintenance Summary:

.1 Compile individual Maintenance Summary for each applicable equipment item, respective unit or system, and for components or sub-units.

.2 Format:

.1 Use Maintenance Summary Form bound with this section or electronic facsimile of such.

.2 Each Maintenance Summary may take as many pages as required.

.3 Use only 8-1/2-inch by 11-inch size paper.

.4 Complete using typewriter or electronic printing. Hand-written and hand-printed entries are will not be accepted.

.3 Include detailed lubrication instructions and diagrams showing points to be greased or oiled; recommend type, grade, and temperature range of lubricants and frequency of lubrication.

.4 Recommended Spare Parts:

.1 Data to be consistent with manufacturer's bill of materials/parts list furnished in O&M manuals.

.2 "Unit" is the unit of measure for ordering the part.

.3 "Quantity" is the number of units recommended.

.4 "Unit Cost" is the current purchase price.

1.7 Data For Materials and Finishes

.1 Content for Architectural Products, Applied Materials, and Finishes:

.1 Manufacturer's data, giving full information on products:

.1 Catalog number, size, and composition.

.2 Color and texture designations.

.3 Information required for reordering special-manufactured products.

.2 Instructions for Care and Maintenance:

.1 Manufacturer's recommendation for types of cleaning agents and methods.

.2 Cautions against cleaning agents and methods that are detrimental to product.

.3 Recommended schedule for cleaning and maintenance.

.2 Content for Moisture Protection and Weather Exposed Products:

.1 Manufacturer's data, giving full information on products:

.1 Applicable standards.

.2 Chemical composition.

.3 Details of installation.

.2 Instructions for inspection, maintenance, and repair.

1.8 Supplements

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

.1 Forms: Maintenance Summary Form.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

DEMONSTRATION AND TRAINING

1. GENERAL

1.1 Description

.1 This Section contains requirements for training the City staff, by persons retained by the Contractor specifically for the purpose of proper operation and maintenance of all equipment supplied and installed under this Contract.

.2 The Contractor shall develop the overall training plans for Unit Processes and Facility Areas with input from the Contractor Administrator, Manufacturers or vendors, and the City. The Contractor shall be responsible for providing qualified training instructors, classroom and field lesson plans as detailed in the Specifications and as described herein.

.3 Arrange for Manufacturers' Representatives to supply detailed classroom and hands-on training to the City's operations personnel, maintenance personnel, and select on-call personnel on operation and maintenance of specified product (system, subsystem, and component) and as may be required in applicable Specifications.

.4 The City will require training for at least two (2) shifts for each specified training session. Allow at least the minimum specified number of hours or days of training for each City staff shift for each specified product (system, subsystem, and component).

.5 To facilitate scheduling of the City personnel, the City may elect to divide sessions into operation-specific topics and maintenance-specific topics as applicable, to allow operations/ on-call staff and maintenance staff to attend separately. The Contractor shall coordinate with the Contract Administrator and the City.

.6 Training will be scheduled at least four (4) weeks in advance of the respective training sessions.

.7 Furnish trained, articulate personnel to coordinate and expedite training, to be present during training coordination meetings with the City and familiar with operation and maintenance manual information specified in Section 01 78 23, Operation and Maintenance Data.

.8 Training sessions to be conducted by qualified Manufacturers' Representatives of the various equipment suppliers, with a minimum of two (2) years' experience. Manufacturers' Representatives shall be familiar with facility operation and maintenance requirements as well as with specified equipment.

.9 The Contract Administrator has the authority to determine if the training is sufficient based on the lesson plan submitted by the Contractor.

.10 Furnish complete training materials, to include operation and maintenance data, to be retained by each trainee.

1.2 Submittals

.1 Submit the following information to the Contract Administrator thirty (30) days prior to the first training session. The material will be returned as either "NO EXCEPTIONS TAKEN", "EXCEPTIONS NOTED" or "EXCEPTIONS NOTED - RESUBMIT".

.1 Lesson plan and supplemental training manuals, handouts, visual aids and other reference material required for each training session.

.2 Submit proposed lesson plan not less than twenty-one (21) days prior to scheduled training and revise as necessary for acceptance.

.3 Lesson Plan: When training of the City personnel is specified, prepare for each required course, a lesson plan containing but not limited to the following 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, including supplemental training manuals, handouts, visual aids and other reference material required for each training session.

.6 Resumes of instructors providing the training.

.4 Training Schedule:

.1 Submit not less than twenty-one (21) calendar days prior to start of equipment installation and revise as necessary for acceptance.

.2 List specified equipment and systems that require training services and show:

.1 Respective manufacturer.

.2 Estimated dates for installation completion.

.3 Estimated training dates.

.3 Adjust schedule to ensure training of appropriate personnel as deemed necessary by the City, and to allow full participation by Manufacturers' Representatives. Adjust schedule for interruptions in operability of equipment.

.4 Individual sessions shall not exceed four (4) hours. A break should be incorporated into sessions that exceed two (2) hours. Training session anticipated to exceed four (4) hours can be assigned to multiple-sessions; however, no more than one (1) - 3-hour and one (1) - 4-hour sessions (seven (7) hours total) may be delivered to the same participants in a single day. Two (2) successive 4-hour sessions may be delivered to alternating shifts of attendees in a single day (i.e., one group of attendees in the morning, and a second group of attendees in the afternoon). Training sessions requiring more than seven (7) hours may be delivered on separate days.

.5 Classes shall not be scheduled concurrently.

1.3 Location and Training Facilities

.1 The City will provide the classroom training facilities.

.2 Field training sessions shall take place at the equipment location.

1.4 Format and Content

.1 The training sessions shall be comprised of both classroom training and field training. As a minimum, they shall cover the following topics for each item of equipment or system:

.1 Training will cover:

.1 Familiarization.

.2 Safety.

.3 Operation.

.4 Troubleshooting.

.5 Preventative and predictive maintenance.

.6 Corrective maintenance.

.7 Parts.

.8 Local representation.

.2 Classroom Training:

.1 As a minimum, classroom equipment/system training must be completed prior to Functional Testing and will include:

.1 The specific equipment location in the plant and operational overview. Use slides and drawings to aid discussion.

.2 Purpose and function of the equipment/system.

.3 The operating theory of the equipment/system.

.4 Start-up, shutdown, normal operation and emergency operating procedures, including system integration and electrical interlocks, if any.

.5 Safety items, standard operation procedures (SOPs), and safe work procedures (SWPs) related to operation of the equipment.

.6 Routine and preventative and predictive maintenance.

.7 Disassembly and assembly of equipment if applicable.

.8 Normal and major repair procedures.

.9 Inspection and troubleshooting procedures including the use applicable test instruments and the “pass” and “no pass” test instrument readings.

.10 Calibration procedures.

.2 The Contractor shall integrate a PCS Demonstration System into any classroom training course where:

.1 The content includes equipment monitoring and control via the HMI.

.2 The content includes alarming and alarm response.

.3 The content includes coordination of maintenance events and states to PCS/HMI status indications.

.4 The use of the PCS Demonstration System would clarify and/or aid in the training of the Training Participants.

.5 Where use of the PCS Demonstration System is included in a training course, the Contractor shall:

.1 Provide the PCS Demonstration System in accordance with the Specifications.

.2 Make certain that the PCS Demonstration System in no way impacts the actual operating PCS or in any other way expose the PCS to any risk of inadvertent operation.

.3 Provide a second projector and screen to display the HMI Operator Workstation to all participants.

.3 Field Training:

.1 As a minimum, field equipment training for operations personnel shall include:

.1 Identification of equipment: location of primary element; location of instrument readout; discussion on purpose, basic operation, and information interpretation.

.2 Discussion and demonstration of standard operating procedures, safe work procedure, and daily visual inspection of system operations.

.3 Discussion and demonstration of the preventative maintenance activities, and predictive maintenance activities where applicable.

.4 Discussion and demonstration of start-up and shutdown procedures.

.5 Demonstration of routine disassembly and assembly of equipment if applicable.

.6 Identification and review of safety items and demonstration of safety procedures, if feasible.

.7 Review of Contractor prepared Operation and Maintenance Manuals.

.8 Demonstration of operating parameter adjustment for optimized equipment/system operation.

1.5 Video Recording

.1 The Contractor shall notify all training providers that the training sessions will be videotaped.

.2 Supply video recording of instruction sessions, including manufacturers' representatives' hands-on equipment instruction and classroom sessions.

.3 Arrange for and carry the cost of videotaping one complete training session for each item of equipment and each system.

.4 The video record of training shall be provided in MPEG-4(.mp4) format. The digital file must be named with course title and reference to the training plan. The files shall be fully indexed and cataloged with file labels stating equipment or system, classroom or field session, and date recorded.

.5 Videotaping shall be by a professional commercial videographer, experienced in shooting training videos, in both good and inclement weather.

.6 Video Format and Quality:

.1 Digital (MPEG-4), with sound.

.2 Video:

.1 Produce bright, sharp, and clear images with accurate colors, free of distortion and other forms of picture imperfections.

.2 Electronically, and accurately display the month, day, year, and time of day of the recording.

.3 Audio:

.1 Audio recorded during documentation shall be done clearly, precisely, and at a moderate pace.

.7 Documentation:

.1 Digital Video Disc (DVD) Label:

.1 Tape number (numbered sequentially, beginning with 001).

.2 Project Name.

.1 Facility name;

.2 Process area and equipment

.8 The digital files shall be fully indexed and cataloged with file labels stating equipment or system, classroom or field session, and date recorded.

.9 Acceptable videographer is McNeill Media Creations (Don McNeill, (204) 224-2578, mmc@shaw.ca) or approved equal in accordance with B7.

1.6 Equipment and Systems for Training

.1 Provide Training for the equipment and systems listed in the following table, and as otherwise Specified:

Equipment / System	**Specification Reference**	**Minimum Number of Person Days for Training, per Shift**
HVAC Fans	01 50 00	2 person days
Heat Recovery System		2 person days
Air Handling Units	21 13 13	1 person day
Odour Control Fans		1 person day
Odour Control System	23 11 10	1 person days
Sludge Bin and Covers	23 34 00	1 person days
Motor Control Centre	26 24 19	3 person days
Variable Frequency Drives	26 29 23	2 person days
Static Uninterruptible Power Supply	26 33 53	4 hours/UPS system
Active Harmonic Filter Power Factory Correction	26 35 33	1 person days
Emergency Lighting System	26 52 02	1 person days
Multiplex Fire Alarm Systems	28 31 02	1 person day
Instrumentation and Control Components	40 91 01	3 person days
Programmable Logic Controller	40 95 33	4 person days
Applications Software	40 96 00	4 person days
Monorail Hoists	41 22 23.19	1 person day
Submersible Pumps	43 21 39.13	1 person day
Chopper Pumps	43 21 39.16	1 person day
Process Electric Water and Eye Wash	43 40 03	2 person days
Polymer Storage and Loading System	46 51 21.16	2 person days
Polymer Pumps	46 66 20	1 person days
Rotary Press and Flocculation	46 71 33	4 person days

1.7 Training Completion Forms

.1 Form T-1 to be signed by the trainer, the Contract Administrator, and by a City Staff representative for each City shift when classroom training has been completed. One (1) form is to be used for each item of equipment and each system for which training has been provided. Once all classroom training sessions have been completed, Form T1 is to be submitted to the Contract Administrator.

.2 Form T-2 to be signed by the trainer, the Contract Administrator, and by a City Staff representative for each City shift when field training has been completed. One (1) form is to be used for each item of equipment and each system for which training has been provided.

Once all field training sessions have been completed, Form T2 is to be submitted to the Contract Administrator.

.3 The supply of adequate training, including completion of Forms T-1 and T-2 is a required prerequisite for handover of equipment, Unit Processes and Facility Areas as appropriate to the City.

1.8 Supplement

.1 Supplements listed below, following "End of Section," is a part of this Specification:

.1 Form T-1 Certificate of Satisfactory Classroom Training.

.2 Form T-2 Certificate of Satisfactory Field Training.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

COMMISSIONING PLAN

1. GENERAL

1.1 Description

.1 Provide a complete and fully functional system ensuring that:

.1 City personnel have been fully trained in aspects of installed systems.

.2 Documentation relating to installed equipment and systems has been completed.

.2 The Contractor shall develop a Detailed Commissioning Plan and Commissioning Schedule using this Section as a Base Commissioning Plan.

.3 Use this Section as a master planning document for Commissioning as it:

.1 Outlines organization, scheduling, allocation of resources, and documentation pertaining to implementation of Commissioning.

.2 Communicates responsibilities of team members involved in Commissioning including scheduling, documentation requirements, and verification procedures.

.3 Sets out deliverables relating to operation, maintenance, process and administration of Commissioning.

.4 Describes how the process of verification meets the design requirements of the completed Works.

.5 Sets out scope, standards, roles and responsibilities, expectations, deliverables and provides:

.1 An overview of Commissioning.

.2 A general description of elements that make up the Detailed Commissioning Plan.

.3 A process and methodology for successful Commissioning.

.4 Ensure the system is also functioning as described in Section 40 61 96 - Process Control Description.

.5 The Contract Administrator shall witness and certify tests and reports of results.

.6 Commissioning activities must be completed before issuance of Substantial Performance.

1.2 Definitions

.1 Acceptance: for the purpose of this Specification Section, acceptance shall be defined as the formal turnover of a system to the City. This shall occur after the successful end of Commissioning of each system through a formal acknowledgement between the Contract Administrator, the City, and the Contractor. Success of the Commissioning period is determined by the Contract Administrator.

.2 Base Commissioning Plan: General Commissioning requirements within this Section to be used in the development of a Detailed Commissioning Plan.

.3 Bumping:

.1 Used to Commission mechanical systems and associated equipment.

.2 Used to Commission, test, and tune instrumentation and process loops.

.4 Architectural and structural systems:

.1 Doors, windows, related hardware.

.2 Overhead doors.

.3 Hoist.

.4 Truck Scales.

.5 Process systems:

.1 Dewatering equipment.

.2 Polymer feed equipment.

.3 Bin cover system.

.4 Process piping, valves and operators.

.5 Instrumentation and control systems.

.6 Festune system.

.7 Odour control system

.8 Process pump station

.6 Plumbing systems:

.1 Domestic CWS and HWS.

.2 Emergency shower/eyewash systems.

.3 Trap primers for floor drains.

.4 Flushing water system.

.7 Heating, ventilation and air conditioning (HVAC) and exhaust systems:

.1 HVAC systems.

.2 Heat Recovery systems.

.3 Exhaust systems and related systems.

.8 Low voltage below 750 V:

.1 Low voltage equipment.

.2 Low voltage distribution systems.

.3 Electronic data and communications information systems.

.4 Security systems.

.5 Lighting systems.

.6 Lighting equipment.

.7 Distribution systems.

.8 Emergency lighting systems, including battery packs.

.9 Fire exit emergency signage.

.9 Fire alarm systems, equipment:

.1 Annunciators.

.2 Control panels.

.3 Fire alarm battery banks.

.10 Instrumentation and control systems:

.1 PLC automation system.

.2 Festune system for Primary Clarifier 4 and 5.

.3 Instrumentation.

.11 Commissioning: for the purpose of this Specification Section, Commissioning shall be defined as the successful operation of components, equipment, systems, subsystems, or integrated systems in accordance with its design requirements for a period of one (1) month, the last seven (7) of which shall be consecutive, unless otherwise specified.

.12 Commissioning Agent: Agent of the Contractor with minimum 10 years of experience in Commissioning, satisfactory to the Contract Administrator, responsible for the oversight and execution of Commissioning.

.13 Commissioning Report: the final Commissioning document as described in Item 3.16.

.14 Commissioning Schedule: Gantt chart showing planned dates for performing all activities related to commissioning of all upgraded systems. The Commissioning Schedule is to be

developed by the Contractor and submitted to the Contract Administrator for review, as described in Item 3.1.

.15 Demonstration: a one-hour demonstration of the successful installation and operation of the equipment.

.16 Detailed Commissioning Plan: Commissioning Plan developed by Contractor from the Base Commissioning Plan to be submitted and reviewed by the Contract Administrator, as described in Item 3.2. Unless defined as “Base Commissioning Plan”, all other instances of “Commissioning Plan” refer to the Detailed Commissioning Plan.

.17 Performance Test: a test in which the equipment is run continuously for seven (7) days (168 hours) or as specified for different equipment. Successful completion of the Performance Test is required for Form 104.

.18 Running Test: a test in which equipment is run continuously for a minimum of three (3) days (seventy-two (72) hours) or as specified for different equipment. During this period, as practicable, conditions shall be simulated which represent maximum or most severe, average, and minimum or least severe conditions. Successful completion of the Running Test is required for Form 103.

.19 System: for the purpose of this Specification section, a system shall be defined as the equipment, piping, controls, ancillary devices, electrical power, etc., which together perform a specific function at the facility.

1.3 Submittals

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

.2 Commissioning Schedule to be submitted and accepted by the Contract Administer as per Item 3.1.

.3 Detailed Commissioning Plan to be submitted and accepted by the Contract Administer as per Item 3.2.

.4 Detailed Commissioning Plan to be refined and resubmitted as required during the construction phase as per Item 3.3.

1.4 Composition, Roles, and Responsibilities of Commissioning Team

.1 Commissioning Team to consist of the following members:

.1 Contract Administrator who is responsible for:

.1 Monitoring Commissioning activities.

.2 Witnessing and certifying reported results.

.3 Reviewing and approving Contractor submissions.

.4 Assisting in the resolution of issues resulting from all tests.

.5 Reviewing the final Commissioning Report.

.2 City personnel who are responsible for:

.1 Attending Commissioning activities to verify re-installed existing equipment, including but not limited to any removed flow meters, operates as per the original sequence of operations.

.2 Attending Commissioning activities to verify newly installed equipment operates as intended.

.3 Performing necessary testing as noted in Item 3.11.

.3 Construction Team: Contractor, Subcontractors, suppliers, and support disciplines, who are responsible for construction/installation in accordance with Contract Documents, including:

.1 Testing.

.2 Mechanical testing, adjusting and balancing (TAB).

.3 Integrating Commissioning activities into the Contractor's Project Schedule (Project Schedule).

.4 Performing and documenting equipment installation as per Section 01 65 00 - Equipment Installation.

.5 Performing and documenting start-up including installation/start-up checklists.

.4 Contractor's Commissioning Agent who is responsible for implementing specified Commissioning activities including:

.1 Planning/preparing checklists (installation/start-up checklists as required, product information) and test procedures.

.2 Determining operational training requirements.

.3 Developing a Detailed Commissioning Plan, updating information provided in the Base Commissioning Plan.

.4 Performing and documenting Running Testing and Performance Testing.

.5 Preparing and updating issues logs.

.6 Verifying, reviewing, and conducting training.

.7 Preparing final Commissioning Report.

1.5 Extent of Commissioning

.1 Testing of electrical panels must be completed before proceeding with Commissioning activities.

.1 Testing after the electrical modifications shall conform to CSA C22.2 No. 14, CSA C22.2 No. 286 and related CSA standards. CSA special inspections shall be coordinated by the Contractor after operation is confirmed.

.2 Commission mechanical systems and associated equipment:

.3 Architectural items

.1 Doors, windows, related hardware.

.2 Overhead doors.

.3 Hoist.

.4 Process systems:

.1 Dewatering equipment.

.2 Polymer feed equipment.

.3 Bin cover system.

.4 Process piping, valves and operators.

.5 Instrumentation and control systems.

.6 Festune system.

.7 Bin scales

.8 Odour control system

.9 Process pump station

.5 Plumbing systems:

.1 Domestic CWS and HWS.

.2 Emergency shower/eyewash systems.

.3 Trap primers for floor drains.

.4 Flushing water system.

.6 Heating, ventilation and air conditioning (HVAC) and exhaust systems:

.1 HVAC systems.

.2 Heat Recovery systems.

.3 Exhaust systems and related systems.

.7 Low voltage below 750 V:

.1 Low voltage equipment.

.2 Low voltage distribution systems.

.3 Electronic data and communications information systems.

.4 Security systems.

.5 Lighting systems.

.6 Lighting equipment.

.7 Distribution systems.

.8 Emergency lighting systems, including battery packs.

.9 Fire exit emergency signage.

.8 Fire alarm systems, equipment:

.1 Annunciators.

.2 Control panels.

.3 Fire alarm battery banks.

2. PRODUCTS

2.1 Equipment

.1 Provide sufficient instrumentation to verify and commission the installed systems.

3. EXECUTION

3.1 Commissioning Schedule

.1 Prepare a detailed Commissioning Schedule and submit to the Contract Administrator for review and approval at the same time as the Project Schedule. Include milestones, testing, documentation, training, and Commissioning activities of components, equipment, subsystems, systems, and integrated systems.

.2 After approval, incorporate the Commissioning Schedule into the Project Schedule.

.3 Contractor, Contractor's Commissioning Agent, and Contract Administrator will monitor progress of Commissioning against the approved Commissioning Schedule.

3.2 Development of Commissioning Plan

.1 This Section is to be considered a Base Commissioning Plan for the UV systems, to be used by the Contractor in the development of a Detailed Commissioning Plan.

.2 The Detailed Commissioning Plan and associated Commissioning Schedule is to be approved by the Contract Administrator at least twenty (20) Business days prior to the planned start of Commissioning. The plan shall comply with the requirements that have been established by the Contract Administrator.

.3 The Detailed Commissioning Plan shall be drafted by the Contractor and reviewed by the Contract Administrator and shall incorporate the contents of the Base Commissioning Plan as specified in this Section. The Detailed Commissioning Plan shall include the following:

.1 A detailed schedule of Commissioning events to be incorporated into the Project Schedule, including but not limited to, the schedule for completion of testing of all component parts of the system.

.2 A sampling and analytical program for tests necessary to verify compliance with the performance specifications.

.3 Inform the Contract Administrator at least fifteen (15) Business Days in advance of conducting the tests and arrange for the attendance of the Manufacturer's Representative. The tests may be concurrent with the inspection of satisfactory installation if mutually agreed by the Contractor and the Contract Administrator.

.4 The Manufacturer's Representative shall conduct all necessary checks to the equipment and if necessary, advise the Contractor of any further checking, flushing, cleaning, or other work needed prior to confirming the equipment is ready to run.

.5 Contingency plans in the event of a process malfunction.

.6 Drawings and sketches as required to illustrate the planned sequence of events.

.7 List and details for all temporary equipment or component (additional spool pieces, etc.) required to facilitate Commissioning.

.8 List of all personnel who the Contractor plans to be in attendance for Commissioning and handover with information indicating their qualifications for this Work.

.4 The Detailed Commissioning Plan to take into account:

.1 Approved Shop Drawings and product data.

.2 Approved changes to the Contract.

.3 Project Schedule.

.4 Contractor's, Subcontractor's, and suppliers' requirements.

.5 Project construction team's and Commissioning team's requirements.

.5 The Detailed Commissioning Plan to include:

.1 Commissioning Schedule.

.2 Installation/start-up check lists provided by manufacturers and suppliers.

.3 Manufacturer Performance Testing forms provided by manufacturers and suppliers.

.1 Forms to include testing parameters at full range of operating conditions to verify responses of equipment and systems.

.6 Submit the completed Detailed Commissioning Plan to the Contract Administrator for review and acceptance. The Detailed Commissioning Plan shall be reviewed prior to its implementation. The Contract Administrator shall be the final arbiter.

3.3 Refinement of Commissioning Plan

.1 During the construction phase, revise, refine, and update the Detailed Commissioning Plan to include approved design and construction changes.

.1 At each revision, indicate revision number and date.

.2 Submit each revised Detailed Commissioning Plan to the Contract Administrator for review and acceptance.

3.4 Equipment

.1 All process, electrical, control, and miscellaneous equipment related to the system shall be successfully installed and tested in accordance with Section 01 65 00, this Section, and any specific requirements noted in other Divisions. Form 103 and Form 104 shall be executed for each piece of major equipment.

.2 Temporary equipment or components will be installed and tested as necessary to ensure that it functions reliably and consistently through the Commissioning period.

3.5 Controls

.1 All controls which are the responsibility of this Contractor shall be installed and tested prior to Commissioning.

.2 The Contractor shall arrange for the simulation of the control sequences at the discretion of Contract Administrator. Every effort shall be made to ensure that the Commissioning period provides for the full and comprehensive operation of the equipment under all anticipated normal and adverse operating conditions.

3.6 Plant Utility Service

.1 The City will provide power and other ancillary services as necessary to operate the facility through the Commissioning period. Provision of these services shall be limited to reasonable levels.

3.7 Manpower

.1 Supply all staff required during Commissioning as necessary to assist the City's staff in the operation of the facility.

.2 Supply competent staff capable of maintaining, repairing, and adjusting the equipment and controls to achieve the intended design functions during the Commissioning period.

.3 Ensure equipment Manufacturer's Representatives are on site to certify adjustments in equipment, to guide in setting correct operating limits, and to generally provide input as required for the appropriate operation of the equipment.

3.8 Operating Descriptions

.1 Operating descriptions shall be prepared by the Contract Administrator for the facility systems. Other information outlining the operating requirements shall also be available from the Contract Administrator. The Contractor will review these descriptions and will make themselves familiar with the requirements in order that they can undertake Commissioning in an appropriate manner.

.1 Operating descriptions shall be considered part of documentation for systems as listed in Item 3.16.2.

3.9 Design Parameters

.1 Design parameters for the system to be commissioned shall be as defined in the Specifications and/or the operating descriptions.

3.10 Pre-Commissioning Activities

.1 Conduct pre-start-up pressure, static, flushing, cleaning, "bumping" testing, and loop validation during construction as specified in the individual sections. This testing to be witnessed and certified by the Contract Administrator and does not form part of Commissioning specifications. Include completed documentation with the Final Commissioning Report.

.2 Perform prestart up inspections prior to commencing Commissioning. Utilise approved installation/start-up check lists if required. Rectify any deficiencies to the Contract Administrator's satisfaction. Include completed documentation with the Final Commissioning Report.

.3 Pre-commissioning activities shall include, at minimum:

.1 Plumbing and process systems:

.1 "Bump" each item of equipment in its "stand-alone" mode.

.2 Complete pre-start-up checks and complete relevant documentation.

.3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.

.2 HVAC equipment and systems:

.1 "Bump" each item of equipment in its "stand-alone" mode.

.2 At this time, complete pre-start-up checks and complete relevant documentation.

.3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.

.4 Perform TAB on systems. TAB reports to be approved by the Contract Administrator.

.4 Electrical:

.1 Emergency power generation systems:

.1 Transfer switches: test by simulating loss of power. Verify the availability of power at equipment requiring same.

.2 Uninterruptible power systems: test under full and partial load conditions.

.2 Lighting systems:

.1 Emergency lighting systems:

.5 Tests to include verification of lighting levels and coverage, initially by disrupting normal power.

3.11 Tests to be Performed by City

.1 City staff may conduct additional sampling for microbiological and/or chemical analysis at their own discretion to supplement testing required by the Contractor as part of this Work.

3.12 Commissioning of Instrumentation and Control

.1 Commissioning activities shall only proceed after instrumentation and control tests have been completed. Refer to Division 26 and Division 40 for additional requirements and test forms.

.2 A minimum written notice of two (2) weeks is required prior to commencing with process commissioning activities. In order to qualify for process commissioning the following activities must be completed:

.1 Instrument Calibrations;

.2 Initial Control Settings and adjustments have been made;

.3 All field devices have been set-u;

.4 Forms (i.e., misc. 100 forms; signed off where required) have been completed;

.5 PLC/SCADA IO and loop checks have been completed; and

.6 Proper mounting and connections have been made.

.3 During Commissioning, demonstrate to the Contract Administrator proper calibration and correct operation of instruments and gauges.

.4 Commissioning of the instrumentation and control system to include but not be limited to the following:

.1 Verify installation of components, wiring connections, and piping connections.

.2 Verify wiring continuity and pipe leak tests.

.3 Verify instrument calibrations and loop tests and provide a written report.

.1 The report shall include record of functional checks and any adjustments required for the instruments and control equipment under operational conditions.

.4 Coordinate instruments and control equipment supplier's service personnel as required for complete system testing.

.5 Coordinate and cooperate with the City, Contract Administrator, and other contractors to commission the Control System I/O points.

.6 Direct plant personnel at hand-over as to final adjustment of the system for correct operation of plant.

.7 Ensure that the instrumentation and control equipment suppliers cooperate to complete the Work.

.8 Verify signal levels and wiring connections to all instrumentation and control equipment.

3.13 Start-Up and Commissioning of Process Equipment

.1 A Manufacturer's Representative shall conduct all necessary checks to the equipment prior to start-up as described in Section 01 65 00 - Equipment Installation.

.2 Following the installation and calibration of the equipment, the Contractor shall perform a Demonstration, Running Test, and Performance Test of the full system. It will be the responsibility of the Contractor to communicate to arrange the times for testing and start-up activities. The Contractor must confirm that these times are acceptable to the Contract Administrator and the City.

.1 During the Demonstration, Running, and Performance tests, the Contractor shall operate equipment as required to meet the requirements from all Divisions of this Specification.

.2 If required, the Contractor shall supply any ancillary equipment or services required to complete the initial Demonstration, Running Test, and Performance Tests.

.3 Should the initial Demonstration, Running Test, or Performance Tests reveal any defects, then those defects shall be promptly rectified and the Demonstration, Running Tests, and/or Performance Tests shall be repeated to the satisfaction of the Contract Administrator.

.4 Additional costs incurred by the Contractor due to repeat Demonstration, Running Tests, and/or Performance Tests shall be borne by the Contractor.

.3 On successful completion of the Demonstration and Running Test, Form 103 – Certificate of Equipment Satisfactory Running Test Performance (Form 103) (attached to this Specification) will be signed by the Manufacturer's Representative, the Contractor, and the Contract Administrator. Form 103 is required for each piece of major equipment, which includes its associated electrical/control modifications by extension.

.4 On successful completion of the Performance Test, Form 104 – Certificate of Equipment Satisfactory Performance Test Performance (Form 104) (attached to this Specification) will be

signed by the Manufacturer's Representative, the Contractor, and the Contract Administrator. Form 104 is required for each piece of major equipment, which includes its associated electrical/control modifications by extension.

.5 Demonstration:

.1 The Contractor shall notify the Contract Administrator of their readiness to demonstrate the operation of the equipment. The Contract Administrator shall attend.

.2 With the assistance of the Manufacturer's Representative, the Contractor shall demonstrate that the equipment is properly installed. Alignment, piping connections, electrical connections, etc. will be checked and if appropriate, code certifications provided.

.3 The equipment shall then be run for one (1) hour. Local controls shall be verified by cycling the equipment through several start-stop operations, modulating its output, or some combination. Operating parameters will be checked to ensure that they are within the specified or Manufacturer's Representative's recommended limits, whichever is more stringent. This step shall be repeated for each modified system.

.4 On satisfactory completion of the one (1) hour demonstration, the equipment shall be stopped and critical parameters shall be rechecked.

.6 Running Test:

.1 The Running Test shall be performed subsequent to modification and successful Demonstration of equipment.

.2 The equipment shall be restarted and run continuously for a minimum of three (3) days (seventy-two (72) hours) or as specified. During this period, as practicable, conditions shall be simulated which represent maximum (or most severe), average, and minimum (or least severe) conditions. These conditions will be mutually agreed to by the Manufacturer's Representative, the Contractor, and the Contract Administrator on the basis of the information contained in the technical specifications, as well as the methods utilized to create the simulated conditions and the time periods allotted to each. This step shall be repeated for each piece of major equipment.

.3 Conduct daily sampling throughout the Running Test.

.1 Submit samples to an accredited laboratory for analysis.

.4 The Running Test shall be completed as follows:

.1 To perform the Running Test, the Contractor, with supervision by the Manufacturer's Representative, shall operate all controls and other devices to ensure they are functional.

.2 The purpose of the Running Test shall be to demonstrate the effectiveness of all system components and control features in all modes of control.

.1 Local control of all devices when local controllers and/or HMI are not in service.

.2 Automatic shutoff and alarm for various failure modes. This includes air monitoring, process monitoring, and shutdown sequences are operating as intended for both life safety and process safety.

.3 Automatic switchover from normal power to emergency power, and emergency power to normal power, if this function has been disturbed by modifications.

.4 Operation of mechanical cleaning system and chemical cleaning system where applicable.

.5 Operation of all monitoring instruments.

.6 All control functions, both at local system, HMI, and SCADA OIT(s).

.5 The Contractor shall submit results of the Running Test within twenty-four (24) hours to the Contract Administrator. Final documented and summarized results shall be submitted in a format acceptable to the Contract Administrator within five (5) Business days.

.1 Results shall include, at a minimum, Pass or Fail status of all tasks and commentary on the performance of each task.

.6 The Contractor, with assistance from the Manufacturer's Representative, shall complete the Running Test to the satisfaction of the Contract Administrator and the City prior to commencing the Performance Test.

.7 Performance Tests:

.1 Following completion of the Demonstration and Running Tests, the Contractor in cooperation with the City's operating staff shall conduct the Performance Test with supervision assistance from the Manufacturer's Representative. The Manufacturer's Representative shall submit to the Contractor, the City, and the Contract Administrator a complete testing plan.

.2 A Performance Test shall be restarted if a critical failure occurs. A critical failure shall be deemed as a failure which prohibits the process from functioning successfully or which creates a safety hazard.

.3 Performance Tests shall be as dictated in this Section, the technical specifications for each piece of equipment, and as reasonably required by the Contract Administrator to prove adherence to the requirements listed in the Specification.

.4 Conduct daily sampling of raw water throughout the Performance Testing.

.1 Submit samples to an accredited laboratory for analysis.

.5 The Contractor shall submit the initial results of each Performance Test within twenty-four (24) hours to the Contract Administrator. Final documented and summarized results shall be submitted in a format acceptable to the Contract Administrator within five (5) Business days.

.6 The Contract Administrator reserves the right to request additional testing. No equipment shall be accepted and handed over to the City prior to the satisfactory completion of the Performance Tests and receipt of the test reports.

.7 To perform the Performance Test, the Contractor in cooperation with City's operating staff shall operate the system with supervision assistance from the Manufacturer's Representative over a seven (7) day test period and collect and summarize data to demonstrate that the system meets the Performance Test requirements for the parameters listed below.

.8 In all cases, compliance with the requirements of this Specification shall be determined for each day of the testing period.

.9 The Manufacturer's Representative shall be responsible for confirming instruments are within the accuracy tolerances required for system operation and performance.

.10 Should the Manufacturer's Representative be off-Site during the Performance Test, the Manufacturer's Representative is to provide full technical supervision (24/7) with telephone support and performance monitoring.

.11 During the Performance Test, the City shall have the option of collecting samples for independent analyses to confirm measurements and analyses conducted by the Manufacturer's Representative and the Contractor. The Contract Administrator and the City shall have the option of witnessing all testing performed by the Manufacturer's Representative and the Contractor.

.12 The Manufacturer's Representative and the Contractor shall provide the Performance Test Report within five (5) Business days of completion of the Performance Test.

.1 The Performance Test Report shall include the following as a minimum:

.1 Performance Test conditions and procedures.

.2 Corrective actions taken.

.3 Retesting results (if necessary).

.4 Other pertinent information (if any).

.5 Conclusions.

.6 Recommendations for future actions.

3.14 Final Commissioning Report

.1 Contractor to submit the completed Commissioning Report within a maximum of two (2) weeks of completion of Commissioning. The final Commissioning Report is to be reviewed and accepted by the Contract Administrator prior to granting Substantial Performance.

.2 Final Commissioning Report to include:

.1 Start-up, pre- Commissioning activities, and documentation for systems and equipment.

.2 Description of Commissioning activities and documentation.

.3 Description of Commissioning of integrated systems and documentation.

.4 Completed installation checklists if required by manufacturer.

.5 Completed Running and Performance Test Report(s).

.6 Final settings of commissioned equipment.

.7 Training Plans.

.3 Before the final Commissioning Report is accepted, individual reported results to be subject to verification by the Contract Administrator.

3.15 Training Plans

.1 Refer to Section 01 79 00 - Demonstration and Training.

CERTIFICATE OF EQUIPMENT SATISFACTORY PERFORMANCE RUNNING TEST FORM 103

We certify that the equipment listed below has been operated and tested as per the Specifications using water and that the equipment meets its Running Testing criteria. No defects in the equipment were found. The equipment is therefore classed as “conforming”.

PROJECT: _____

ITEM OF EQUIPMENT: _____

_____

TAG NO: _____

REFERENCE SPECIFICATION: _____

_____ _____
(Authorized Signing Representative of the Manufacturer) Date

_____ _____
(Authorized Signing Representative of the Contractor) Date

_____ _____
(Authorized Signing Representative of the Contract Administrator) Date

Acknowledgement of Receipt of O&M Manuals.

_____ _____
(Authorized Signing Representative of the City) Date

CERTIFICATE OF SATISFACTORY PERFORMANCE TEST PERFORMANCE FORM 104

We certify that the equipment listed below has been operated and tested as per the Specifications using water and that the equipment meets its Performance Testing criteria. No defects in the equipment were found. The equipment is therefore classed as “conforming”.

PROJECT: _____

SYSTEM DESCRIPTION: _____

_____

TAG NO (S): _____

REFERENCE SPECIFICATION (S): _____

_____ _____
(Authorized Signing Representative of the Manufacturer) Date

_____ _____
(Authorized Signing Representative of the Contractor) Date

_____ _____
(Authorized Signing Representative of the Contract Administrator) Date

_____ _____
(Authorized Signing Representative of the City) Date

SELECTIVE SITE DEMOLITION

1. GENERAL

1.1 Summary

.1 Comply with Division 1, General Requirements.

1.2 References

.1 Comply with the latest edition of the following statutes codes and standards and all amendments thereto.

.1 CSA S350-M 1980 Code of Practice for Safety in Demolition of Structures.

.2 NFPA 241 Safeguarding Building Construction and Demolition Operations.

1.3 Submittals

.1 Submit cleaning operation schedule.

.2 Submit Shop Drawings for bracing and shoring signed and sealed by a licensed engineer.

.3 Submit for review proposed method of substrate preparation.

2. PRODUCTS (NOT USED)

3. EXECUTION

3.1 Preparation

.1 Disconnect electrical and mechanical systems in areas of selective demolition to rules and regulations of Authorities Having Jurisdiction. Submit work request to City minimum two (2) weeks prior.

.2 Post warning signs on equipment, which will remain in operation in areas of selective demolition.

.3 Disconnect and cap mechanical services in accordance with requirements of local Authority Having Jurisdiction or pay for having this work done by local authority.

.4 Do not disrupt active or energized utilities in area of selective demolition.

3.2 Demolition

.1 Do work in accordance with CSA-S350.

.2 Work of this Section is of selective nature. The work includes but not necessarily limited to removal and dismantling of:

.1 Remove concrete or portions of concrete where shown on Drawings.

.2 Remove and store, existing facing Tyndal Stone veneer at following locations.

.1 Where new building attached to an existing building at exterior walls.

.2 Where required to modify opening/s for doors, louvers and/or window at an existing exterior wall.

.3 Where shown on Drawings.

.4 Provide necessary support to keep un-demolished portion of an existing exterior walls intact/s.

.3 Relocate.

.4 Clean.

.3 Demolish in manner to minimize dusting. Keep dusty materials wetted.

3.3 Existing Conditions

.1 Take over existing structure, with selective demolition work based on existing condition at time of examination prior to bidding. Carefully examine existing structure, equipment and conditions.

.2 Protect existing structures, equipment and conditions to minimize damage to existing structures, equipment and conditions.

.3 Make good existing finishes disturbed or otherwise damaged during selective demolition, by qualified tradesmen. Match existing materials and finishes to same or better condition at no cost to the City.

.4 Make good existing materials and finishes disturbed or otherwise damaged by alterations to mechanical and electrical equipment and piping. Match existing materials and finishes to same or better condition at no cost to the City.

3.4 Protection

.1 Prevent movement, settlement, or damage of existing structure and adjacent structures, walks, paving and parts of existing building to remain in service.

.2 Prevent debris from collecting and blocking mechanical and electrical systems, which will remain in operation.

.3 Prevent dust from leaving the source and from entering mechanical and electrical system. Maintain water and electrical systems.

.4 Where openings are scheduled in existing masonry, remove sufficient existing masonry units for toothing-in of new masonry units.

.5 Protect interior of parts and items, which are not to be demolished, from exterior elements at all times.

.1 Maintain water and airtight enclosures.

.2 Provide thermal barrier to match existing exterior thermal barrier.

.3 Protect building service lines from damage.

.6 Turn over to the City, dismantled items, which are in good condition, and store at location within 25 km of the plant and as directed by the Contract Administrator.

3.5 Cleaning

.1 After selective demolition clean existing substrates to sound, clean surface free from extraneous matter. Use only non-ionic surfactants.

.2 Where openings are scheduled in existing masonry, remove sufficient existing masonry units for footing in of new masonry units.

.3 Test clean area designated by the Contract Administrator. Use accepted, cleaned area as the standard for the remainder of the cleaning work.

3.6 Disposal of Waste

.1 Dispose waste off site at location acceptable to Authorities Having Jurisdiction.

.2 Remove waste from Site daily. Do not store on Site.

.3 Do not use waste as fill.

3.7 Cleaning - Masonry

.1 Preparation:

.1 Clean existing masonry to extent shown.

.1 Seal, pack with removable masking, or repair defective jointing and other openings in the work area to minimize water, dust or solvent infiltration of the masonry wall.

.2 Dry brush and if necessary scrape large accumulations of foreign matter from walls, ledges, cornices and the like. Use moderate pressure 345 kPa dry air blasts to remove as much loosely attached soil and dust as possible before commencing main cleaning operations. Exercise care when blasting around decorative material or extremely friable masonry.

.3 Wet the masonry surface soiling by soaking with a low-pressure misting system to swell and loosen soiling.

.4 Use as little water as possible; keep soiling moist. Avoid excessive wetting and soaking of the masonry. Ensure water used does not penetrate the building.

.5 Use nozzles that give a nebulized droplet spray. Maintain a constant nozzle distance from wall face. Vary nozzle pressure to suit cleaning requirements without damaging the masonry surfaces.

.6 Do not use strongly acidic water on carbonate material such as limestone or calcareous sandstones, or masonry bounded with lime mortar.

.7 Establish details of the setup of equipment, incorporate of other related and accepted cleaning methods, and degree of cleaning achieved at the beginning of the job during the test patch operations.

.8 Brush heavily soiled areas with natural bristle or nylon brushes and scrape with wood or plastic tools to loosen deposits and improve the action of the water misting.

.9 Employ a final rinse-down with a pressurized water spray when the soiling reaches a state that allows easy removal without over-working of the masonry surface with the gun and without damaging the masonry.

.10 Make the cleaned masonry surfaces free of foreign matter and uniform in appearance without streaks or variations caused in the cleaning process.

.11 The finish of the masonry after cleaning generally to match the test-cleaned area. If excessive scaling or roughness occurs during cleaning operations, cease operations and notify the Contract Administrator promptly.

.12 Ensure that manufacturer's proprietary materials for cleaning are free from materials detrimental to appearance or performance of the masonry facing.

.13 At completion of the work, remove masking and protective covers and thoroughly clean the glass surfaces on the exterior of the building.

END OF SECTION

HAZARDOUS MATERIALS

1. GENERAL

1.1 References

.1 Definitions:

.1 Dangerous Goods: any product, substance, or organism specifically listed or meets hazard criteria established in Transportation of Dangerous Goods Regulations.

.2 Hazardous Material: any product, substance, or organism used for its original purpose, and is either dangerous goods or material that will cause adverse impact to environment or adversely affect health of persons, animals, or plant life when released into the environment.

.3 Hazardous Waste: hazardous material no longer used for its original purpose intended for recycling, treatment or disposal.

.2 Reference Standards:

.1 Canadian Environmental Protection Act, 1999 (CEPA 1999):

.1 Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations (SOR/2005-149).

.2 Department of Justice Canada (Jus):

.1 Transportation of Dangerous Goods Act, 1992 (TDG Act) 1992, (c. 34).

.2 Transportation of Dangerous Goods Regulations (T-19.01-SOR/2001-286).

.3 Health Canada / Workplace Hazardous Materials Information System (WHMIS):

.1 Material Safety Data Sheets (MSDS).

.4 National Research Council Canada Institute for Research in Construction (NRC-IRC):

.1 National Fire Code of Canada-(2015).

1.2 Action and Informational Submittals

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

1.3 Product Data

.1 Submit manufacturer's instructions, printed product literature and data sheets for hazardous materials and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit one (1) electronic copy of WHMIS MSDS in accordance with Section 01 35 43 - Environmental Procedures to Contract Administrator for each hazardous material required prior to bringing hazardous material on Site.

.3 Submit hazardous materials management plan to Contract Administrator that identifies hazardous materials, usage, location, personal protective equipment requirements, and disposal arrangements.

1.4 Delivery, Storage and Handling

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

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

.3 Transport hazardous materials and wastes in accordance with Transportation of Dangerous Goods Act, Transportation of Dangerous Goods Regulations, and applicable provincial regulations.

1.5 Storage and Handling Requirements

.1 Co-ordinate storage of hazardous materials with Contract Administrator and abide by internal requirements for labelling and storage of materials and wastes.

.2 Store and handle hazardous materials and wastes in accordance with applicable federal and provincial laws, regulations, codes, and guidelines.

.3 Store and handle flammable and combustible materials in accordance with National Fire Code of Canada requirements.

.4 Store flammable and combustible liquids, such as gasoline, kerosene and naphtha, in approved safety cans bearing the Underwriters' Laboratory of Canada or Factory Mutual seal of approval.

.5 Transfer of flammable and combustible liquids is prohibited within buildings.

.6 Transfer flammable and combustible liquids away from open flames or heat-producing devices.

.7 Solvents or cleaning agents must be non-flammable or have flash point above 38°C.

.8 Store flammable and combustible waste liquids for disposal in approved containers located in safe, ventilated area. Keep quantities to minimum.

.9 Observe smoking regulations, smoking is prohibited in areas where hazardous materials are stored, used, or handled.

.10 Storage requirements for quantities of hazardous materials and wastes in excess of 5 kg for solids, and 5 L for liquids:

.1 Store hazardous materials and wastes in closed and sealed containers.

.2 Label containers of hazardous materials and wastes in accordance with WHMIS.

.3 Store hazardous materials and wastes in containers compatible with that material or waste.

.4 Segregate incompatible materials and wastes.

.5 Ensure that different hazardous materials or hazardous wastes are stored in separate containers.

.6 Store hazardous materials and wastes in secure storage area with controlled access.

.7 Maintain clear egress from storage area.

.8 Store hazardous materials and wastes in location that will prevent them from spilling into environment.

.9 Have appropriate emergency spill response equipment available near storage area, including personal protective equipment.

.10 Maintain inventory of hazardous materials and wastes, including product name, quantity, and date when storage began.

.11 When hazardous waste is generated on Site:

.1 Co-ordinate transportation and disposal with Contract Administrator.

.2 Comply with applicable federal, provincial and municipal laws and regulations for generators of hazardous waste.

.3 Use licensed carrier authorized by provincial authorities to accept subject material.

.4 Before shipping material obtain written notice from intended hazardous waste treatment or disposal facility it will accept material and it is licensed to accept this material.

.5 Label containers with legible, visible safety marks as prescribed by federal and provincial regulations.

.6 Only trained personnel shall handle, offer for transport, or transport dangerous goods.

.7 Provide photocopy of shipping documents and waste manifests to Contract Administrator.

.8 Track receipt of completed manifest from consignee after shipping dangerous goods. Provide photocopy of completed manifest to Contract Administrator.

.9 Report discharge, emission, or escape of hazardous materials immediately to Contract Administrator and appropriate provincial authority. Take reasonable measures to control release.

.10 Ensure personnel have been trained in accordance with Workplace Hazardous Materials Information System (WHMIS) requirements.

.11 Report spills or accidents immediately to Contract Administrator. Submit a written spill report to Contract Administrator within twenty-four (24) hours of incident.

2. PRODUCTS

2.1 Materials

.1 Description:

.1 Bring on Site only quantities hazardous material required to perform Work.

.2 Maintain MSDS in proximity to where materials are being used. Communicate this location to personnel who may have contact with hazardous materials.

3. EXECUTION

3.1 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Construction Waste Management Disposal.

.1 Dispose of hazardous waste materials in accordance with applicable federal and provincial acts, regulations, and guidelines.

.2 Recycle hazardous wastes for which there is approved, cost effective recycling process available.

.3 Send hazardous wastes to authorized hazardous waste disposal or treatment facilities.

.4 Burning, diluting, or mixing hazardous wastes for purpose of disposal is prohibited.

.5 Disposal of hazardous materials in waterways, storm or sanitary sewers, or in municipal solid waste landfills is prohibited.

.6 Dispose of hazardous wastes in timely fashion in accordance with applicable provincial regulations.

.7 Minimize generation of hazardous waste to maximum extent practicable. Take necessary precautions to avoid mixing clean and contaminated wastes.

.8 Identify and evaluate recycling and reclamation options as alternatives to land disposal, such as:

.1 Hazardous wastes recycled in manner constituting disposal.

.2 Hazardous waste burned for energy recovery.

.3 Lead-acid battery recycling.

.4 Hazardous wastes with economically recoverable precious metals.

END OF SECTION

ASBESTOS ABATEMENT – TYPE 1

1. GENERAL

1.1 Section Includes

.1 Requirements and procedures for asbestos abatement of Type 1 (Low Risk) work related to chrysotile asbestos-containing materials of the type describe within.

1.2 References

.1 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-1.205-2003, Sealer for Application of Asbestos-Fibre Releasing Materials.

.2 Department of Justice Canada (Jus):

.1 Canadian Environmental Protection Act, 1999 (CEPA).

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

.1 Material Safety Data Sheets (MSDS).

.4 The Government of Manitoba, Workplace Safety and Health Division (WSH):

.1 Chapter W210 10/02, The Workplace Safety and Health Act, Manitoba Workplace Safety and Health Act and Regulation, 2015.

.2 Guidelines for Working With Asbestos, 2008 (WSH).

.5 Transport Canada (TC):

.1 Transportation of Dangerous Goods Act, 1992 (TDGA).

.6 Underwriters' Laboratories of Canada (ULC).

.7 City of Winnipeg – Appendix A – Primary Clarifier Asbestos Report.

1.3 Scope of Work

.1 Refer to Item 1.3 of Section 02 82 13, Asbestos Abatement – Type 3.

.2 Section 02 82 11, Asbestos Abatement – Type 1 defines procedures and requirements only for handling non-friable asbestos. Performance of such work is responsibility of each Section required to handle, cut, drill, or remove non-friable asbestos as necessary to perform work of their respective Sections. Such work shall be done in strict accordance with handling requirements specified in Section 02 82 11, Asbestos Removal – Type 1.

.3 Demolish and dispose underground sanitary sewer and storm water pipes, which are asbestos containing materials as required to complete the Work. Laws of province of Manitoba shall govern this Work.

.4 Contractor shall observe all such laws and shall obtain and pay all permits, notices, fees, taxes, duties as may be required. Likewise, it is responsibility of contractor to comply with the *Manitoba Workplace Safety and Health Act and Regulation*.

.5 Comply with requirements of this Section when performing following Work:

.1 Removal of Type 1 asbestos-containing materials as required to complete the Work.

.6 Approximate locations and quantities are provided in Appendix A. These values are for information purposes only. Prior to tender, the Contractor shall be solely responsible to obtain and verify quantities and locations on-site and confirm that all known asbestos-containing materials have been included in the lump sum bid.

.7 Abate, load, transport and dispose of all known hazardous building materials including asbestos, requiring removal to complete the Work, prior to demolition. The City reserves the right to request modifications to the Contractors Abatement Plan as appropriate to meet minimum expectations of safety.

.8 The Contractor shall be responsible for obtaining information regarding the types of materials identified by reviewing and understanding the information provided in the reports and reference drawings, and by reviewing the City Site to confirm and satisfy any assumptions made on the material types and quantities.

.9 The Contractor shall include Type 1 asbestos abatement work in the Detailed Abatement Plan as described in Section 02 82 13, Asbestos Abatement – Type 3.

.10 Removal of articles remaining in the Facility at commencement of the Work is the responsibility of the Contractor.

.11 Containment, removal, and disposal of materials on the property at commencement of the work is the responsibility of the Contractor. Measures and procedures for dust suppression, worker protection, and waste collection shall be provided to satisfy requirements safety requirements.

.12 Maintain only emergency electrical and mechanical services passing through asbestos work area. All other services must be deactivated during abatement work.

.13 Provide heat, water, and power where necessary to perform the Work.

.14 Provide necessary cranes, lifting devices, scaffolding, elevated work platforms, and safety equipment to adequately complete the work and maintain worker safety. The Contractor shall provide the Contract Administrator stamped drawings and approvals for scaffolding and work platforms where required by law and as otherwise specified.

.15 All work will be subject to inspection and air monitoring inside and outside asbestos work area by the City's Contract Administrator. Any contamination of surrounding areas, indicated by visual inspection or air monitoring, shall necessitate complete clean-up of affected areas at no additional cost to the City.

.16 Contractor to erect a project health and safety board. Health and safety board to contain contact information, MSDS's, Safety Policy, AHAs, project specifications, project reports, site specific environmental remediation strategy and action plan, etc.

.17 Notify Manitoba Workplace Safety and Health at least five (5) days prior to beginning abatement work.

.18 Ensure all necessary permits for asbestos abatement work, variance, demolition, etc. are posted at the Site prior to start of work.

1.4 Definitions

.1 Refer to Item 1.4 of Section 02 82 13, Asbestos Abatement – Type 3.

1.5 Submittals

.1 Refer to Item 1.5 of Section 02 82 13, Asbestos Abatement – Type 3.

1.6 Regulations

.1 Refer to Item 1.6 of Section 02 82 13, Asbestos Abatement – Type 3.

1.7 Supervision

.1 Refer to Item 1.7 of Section 02 82 13, Asbestos Abatement – Type 3.

1.8 Quality Assurance

.1 Refer to Item 1.8 of Section 02 82 13, Asbestos Abatement – Type 3.

1.9 Definitions

.1 HEPA Filter: High Efficiency Particulate Aerosol filter at least 99.97% efficient in collecting 0.3 micrometer aerosol.

.2 Non Friable Material: Material that when dry cannot be crumbled, pulverized or powdered by hand pressure. Includes, but not limited to, following asbestos containing products: vinyl asbestos floor tiles, resilient sheet flooring, acoustic ceiling and wall tiles, gaskets, seals, packings, friction products, drywall joint compounds and asbestos cement panels, shingles and piping.

.3 Gryphlon Sheeting: Gryphlon sheeting of 0.15 mm (6 mil) minimum thickness with tape seals along edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide continuous membrane protection.

.4 Authorized Visitor(s): The City's Third Party Inspector or person(s) representing regulatory agencies, and person(s) authorized by them.

.5 Asbestos Work Area(s): Area(s) where work takes place which will, or may, disturb asbestos containing material.

1.10 Submittals

.1 Refer to Item 1.2 of Section 02 82 13, Asbestos Abatement – Type 3.

1.11 Regulations

.1 Refer to Item1.6 of Section 02 82 13, Asbestos Abatement – Type 3.

1.12 Supervision

.1 Refer to Item1.7 of Section 02 82 13, Asbestos Abatement – Type 3.

1.13 Quality Assurance

.1 Refer to Item1.8 of Section 02 82 13, Asbestos Abatement – Type 3.

1.14 Worker and Visitor Protection

.1 Respirators are not mandatory for work with non-friable asbestos containing materials, however, for this project, provide non-powered air half face respirator with minimum P100 filter cartridges in accordance with NIOSH Part 84 requirements. Provide proper instruction to workers in use of respirators including qualitative and quantitative fit testing. Replace filters as necessary, according to manufacturer's instructions. Workers shall not wear facial hair that affects seal between respirator and face. Contractor to post on job bulletin City instructions, procedures and information pertaining to abatement work.

.2 Provide, and insist on using, facilities for washing of hands and face by every worker when leaving asbestos work area. Prohibit smoking, eating and drinking in asbestos work area.

2. PRODUCTS

2.1 Materials

.1 Asbestos Waste Receptors: Two separate containers of which 1 shall consist of 0.15 mm (true 6 mil) minimum thickness sealable polyethylene bag. Other container may be 0.15 mm (true 6 mil) minimum thickness polyethylene bag. Outer container shall be adequate to prevent perforating rips, or tears during filling, transport or disposal. Containers must be acceptable to disposal facility selected, and WSH, and shall be clearly marked to indicate that contents contain asbestos.

.2 HEPA Vacuum: Vacuum with all necessary fittings, tools and attachments. Air must pass HEPA filter before discharge.

.3 Sprayer: Garden type portable manual sprayer, low velocity, capable of producing mist or fine spray.

.4 Gryphlon Sheeting: 0.15 mm (6 mil) minimum thickness unless otherwise specified; in sheet size to minimize joints.

.5 Tape: Tape suitable for sealing gryphlon to surface encountered under wet conditions using amended water and under dry conditions.

.6 Amended Water: Water with non-ionic water wetting agent added.

3. EXECUTION

3.1 Preparation

.1 Before disturbing non friable asbestos materials except those used as flooring, cover floor and furnishings below work with gryphlon sheeting.

.2 Wherever dust on surface within asbestos work area is likely to be disturbed, remove beforehand with HEPA vacuum or damp cloth.

3.2 Removal of Vinyl Asbestos Tile

.1 Start removal by wedging heavy-duty scraper in seam of two adjoining tiles and gradually forcing edge of 1 tile up and away from floor. Do not break off pieces of tile, but continue to force balance of tile up.

.2 When first tile is removed, place it, without breaking into smaller pieces, into asbestos waste receptor.

.3 Continue removal of tiles using hand tools and removing tiles intact wherever possible. When adhesive is spread heavily or is quite hard, it may prove easier to force scraper through tightly adhered areas by striking scraper handle with hammer using blows of moderate force while maintaining scraper at 25 to 30 degree angle to floor. When even this technique cannot loosen tile, removal can be simplified by heating tile with hot air gun or infrared heaters until heat penetrates through tile and softens adhesive. Do not use powered electric scrapers.

.4 After removal of small area scrape up adhesive remaining on floor with hand scraper until only thin smooth film remains. Where deposits are heavy or difficult to scrape, hot air gun or infrared heaters may be used. Deposit scrapings into asbestos waste receptors. Do not dry scrape surface of adhering pieces of tile.

.5 On completion of area, clean floor with HEPA vacuum.

3.3 Removal of Other Non Friable Asbestos Materials

.1 Where possible wet material to be disturbed.

.2 Place drop sheets on ground surfaces within work area and isolate exterior work area using yellow caution tape. Use hand scraping to remove material adhering to substrate.

.3 Immediately place removed material in asbestos waste receptor. Clean surrounding surfaces and asbestos work area frequently with HEPA vacuum or with wet methods.

.4 Dispose of drop sheets as asbestos waste. Do not reuse.

3.4 Inspection

.1 Refer to Item 3.13 of Section 02 82 13, Asbestos Abatement – Type 3.

3.5 Waste Transport and Disposal

.1 Conform to requirements of national and provincial regulations and guidelines related to the transportation and disposal of hazardous waste.

.2 Check with waste disposal facility to determine type of waste containers acceptable.

.3 Waste disposal shall be sent to a disposal facility approved by the City.

.4 Check with waste disposal facility to determine type of waste containers acceptable.

.5 Ensure shipment of containers to waste disposal facility is taken by waste hauler licensed to transport asbestos waste.

.6 Each load requires completion of bill of lading showing type and weight of hazardous waste being transported. Provide copies of bill of lading indicating acceptance of waste at waste disposal facility.

.7 Co-operate with third party inspectors and immediately carry out instructions for remedial work at dump to maintain environment, at no additional cost to the City.

.8 Ensure waste disposal facility is fully aware of hazardous material being dumped.

.9 Ensure that containers used for disposal are locked and covered at all times.

END OF SECTION

1. GENERAL

1.1 Section Includes

.1 Requirements and procedures for asbestos abatement of Type 2 (Medium Risk) work related to chrysotile asbestos-containing materials of the type describe within.

1.2 References

.1 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-1.205-2003, Sealer for Application of Asbestos-Fibre Releasing Materials.

.2 Department of Justice Canada (Jus):

.1 Canadian Environmental Protection Act, 1999 (CEPA).

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

.1 Material Safety Data Sheets (MSDS).

.4 The Government of Manitoba, Workplace Safety and Health Division (WSH):

.1 Chapter W210 10/02, The Workplace Safety and Health Act, Manitoba Workplace Safety and Health Act and Regulation, 2015.

.2 Guidelines for Working With Asbestos, 2008 (WSH).

.5 Transport Canada (TC):

.1 Transportation of Dangerous Goods Act, 1992 (TDGA).

.6 Underwriters' Laboratories of Canada (ULC).

.7 City of Winnipeg – Appendix A – Primary Clarifier Asbestos Report.

1.3 Scope of Work

.1 Refer to Item 1.3 of Section 02 82 13, Asbestos Abatement – Type 3.

.2 Laws of province of Manitoba shall govern this work. Contractor shall observe all such laws and shall obtain and pay all permits, notices, fees, taxes, duties as may be required. Likewise, it is responsibility of contractor to comply with the *Manitoba Workplace Safety and Health Act and Regulation*.

.3 Comply with requirements of this Section when performing following Work:

.1 Removal of Type 2 asbestos-containing materials as required to complete the Work.

.4 Approximate locations and quantities are provided in Appendix A. These values are for information purposes only. Prior to tender, the Contractor shall be solely responsible to obtain and verify quantities and locations on-site and confirm that all known asbestos-containing materials have been included in the lump sum bid.

.5 Abate, load, transport and dispose of all known hazardous building materials including asbestos, requiring removal to complete the Work, prior to demolition. The City reserves the right to request modifications to the Contractors Abatement Plan as appropriate to meet minimum expectations of safety.

.6 The Contractor shall be responsible for obtaining information regarding the types of materials identified by reviewing and understanding the information provided in the reports and reference drawings, and by reviewing the City Site to confirm and satisfy any assumptions made on the material types and quantities.

.7 The Contractor shall include Type 2 asbestos abatement work in the Detailed Abatement Plan as described in Section 02 82 13, Asbestos Abatement – Type 3.

.8 Removal of articles remaining in the Facility at commencement of the work is the responsibility of the Contractor.

.9 Containment, removal, and disposal of materials on the property at commencement of the work is the responsibility of the Contractor. Measures and procedures for dust suppression, worker protection, and waste collection shall be provided to satisfy safety requirements.

.10 Maintain only emergency electrical and mechanical services passing through asbestos work area. All other services must be deactivated during abatement work.

.11 Provide heat, water, and power where necessary to perform the Work.

.12 Provide necessary cranes, lifting devices, scaffolding, elevated work platforms, and safety equipment to adequately complete the work and maintain worker safety. The Contractor shall provide the Contract Administrator stamped drawings and approvals for scaffolding and work platforms where required by law and as otherwise specified.

.13 All work will be subject to inspection and air monitoring inside and outside asbestos work area by the City or the Contract Administrator. Any contamination of surrounding areas, indicated by visual inspection or air monitoring, shall necessitate complete cleanup of affected areas at no additional cost to the City.

.14 Contractor to erect a project health and safety board. Health and safety board to contain contact information, MSDS's, Safety Policy, AHAs, project specifications, project reports, site specific environmental remediation strategy and action plan, etc.

.15 Notify Manitoba Workplace Safety and Health at least five (5) days prior to beginning abatement work.

.16 Ensure all necessary permits for asbestos abatement work, variance, demolition, etc. are posted at the Site prior to start of work.

1.4 Definitions

.1 Refer to Item 1.4 of Section 02 82 13, Asbestos Abatement – Type 3.

1.5 Submittals

.1 Refer to Item 1.5 of Section 02 82 13, Asbestos Abatement – Type 3.

1.6 Regulations

.1 Refer to Item 1.6 of Section 02 82 13, Asbestos Abatement – Type 3.

1.7 Supervision

.1 Refer to Item 1.7 of Section 02 82 13, Asbestos Abatement – Type 3.

1.8 Quality Assurance

.1 Refer to Item 1.8 of Section 02 82 13, Asbestos Abatement – Type 3.

1.9 Worker and Visitor Protection

.1 Instructions: Before entering asbestos work area(s), instruct workers and visitors in use of respirators, entry and exit from enclosures and all aspects of work procedures and protective measures. Instruction shall be provided by a person who is trained to competently perform this task.

.2 Full Face Respirator: During wet removal and cleanup in enclosed asbestos work area workers, supervisors, and authorized visitors shall be supplied with and use powered air-purifying full-face respirator (PAPR) with N-100, R-100 or P-100 filters. Replace filters daily or test according to manufacturer's specifications and replace as indicated. Provide proper instruction to workers and visitors in use of respirators, cleaning, inspection, and storage and ensure all personnel and visitors are fit-tested using qualitative and/or quantitative techniques. Maintain respiratory protection equipment in proper functioning and clean condition. No supervisor, worker or authorized visitor shall wear facial hair which affects seal between respirator and face. Maintain respiratory protection equipment in proper functioning and clean condition, or remove from Site.

.3 Protective Clothing: Provide workers and visitors in full-enclosure sites with full body coveralls with integral hoods. Once coveralls are worn in asbestos work area, dispose of as contaminated waste. Workers and visitors shall wear other protective apparel required by regulations, including but not limited to: hard hats, safety shoes, and hearing protection.

.4 Before entering enclosure(s) put on respirator with new or tested filters, clean coveralls and head covers. Wear coveralls with hoods up at all times.

.5 Workers may leave enclosure, only after all disturbance of asbestos-containing materials is complete and enclosure has been cleaned-up. When leaving enclosure workers and visitors use HEPA vacuum to clean exterior of respirator to remove visible contamination, and remove gross contamination from coveralls and other protective equipment. Immediately upon leaving enclosure workers and visitors shall remove coveralls and wash face and hands thoroughly with soap and water; wet clean inside of respirator. Remove filters and dispose of or test filters according to manufacturer's specifications. Place coveralls and used filters in receptacles for disposal with other asbestos contaminated materials. Coveralls can be reused, to maximum of eight (8) hours wear, if coveralls remain inside work area.

.6 Do not eat, drink, smoke or chew gum or tobacco except in established locations outside the Asbestos Work Area.

.7 Workers and visitors shall be fully protected as specified herein whenever possibility of disturbance of asbestos exists.

.8 Compressed air shall not be used to clean up or remove dust from any surface.

2. PRODUCTS

2.1 Materials

.1 Polyethylene Sheeting: 0.15 mm (6 mil) minimum thickness unless otherwise specified; in sheet size to minimize joints.

.2 Rip-Proof Polyethylene: 0.20 mm (8 mil) fabric made up from 0.13 mm (5 mil) weave and two (2) layers 0.04 mm (1.5 mil) poly laminate, in sheet size to minimize joints.

.3 Tape: Tape suitable for sealing polyethylene to surface encountered under both wet conditions using amended water, and dry conditions.

.4 Wetting Agent: Non-foaming surface active agent; mixed with water in concentration to provide thorough wetting of asbestos fibre: Standard of Acceptance, Asbesto-Wet, distributed by Asbetec Distributors, or approved equal in accordance with B7, with approval from Contract Administrator.

.5 Amended Water: Water with wetting agent added.

.6 Asbestos Waste Receptors: Two (2) separate containers of which one (1) shall consist of 0.15 mm (true 6 mil) minimum thickness sealable polyethylene bag. Other container may be 0.15 mm (true 6 mil) minimum thickness polyethylene bag. Outer container shall be adequate to prevent perforating rips, or tears during filling, transport or disposal. Containers must be acceptable to disposal facility selected, and WSH, and shall be clearly marked to indicate that contents contain asbestos.

.7 Slow - drying sealer: non-staining, clear, water - dispersible type that remains tacky on surface for at least eight (8) hours and designed for purpose of trapping residual asbestos fibres.

.1 Sealer: flame spread and smoke developed rating less than 5.

.8 Sprayer: Garden-type portable manual sprayer, low velocity, capable of producing mist or fine spray.

.9 HEPA Vacuum: Vacuum with all necessary fittings, tools and attachments. Air must pass HEPA filter before discharge.

3. EXECUTION

3.1 Full-Enclosure Asbestos Work Areas

.1 Move equipment, tools, and stored materials which can be moved without disturbing asbestos-containing materials.

.2 Remove elements which can be removed without disturbing friable asbestos material.

.3 If working from within building, arrange to disable the air handling and ventilation systems supplying or exhausting from asbestos work area enclosure(s) as required. Ensure air-handling systems remain disabled for duration of Work.

.4 Erect wood or metal framing between asbestos work area and remaining building area, as necessary to support polyethylene sheeting enclosures. Free standing enclosure shall have completely sealed polyethylene top.

.5 Use sufficient layers to provide adequate protection. Protect floors with at least one (1) layer of polyethylene sheeting. Where walls are protected with sheeting, cover floors first so that wall polyethylene overlaps floor layer by at least 300 mm (12 inches).

.6 Where applicable clean previously contaminated surfaces with HEPA vacuum before covering with sheeting.

.7 If enclosure is used for more than 1 shift, construct airlock for entry to and exit from enclosure. Clean enclosure prior to exiting at completion of each shift.

.8 Establish negative pressure in asbestos work area as described in Section 02 82 13, Asbestos Abatement – Type 3. Operate negative pressure units or HEPA vacuums continuously from this time until completion of contaminated work.

.9 Provide soap, water and towels for washing of worker's face and hands when exiting enclosure.

.10 Maintain emergency and fire exits from asbestos work area, or establish alternative exits satisfactory to Authorities Having Jurisdiction.

.11 Ensure existing power supply to asbestos work area is isolated and disconnected where necessary. Do not disrupt power supply to remainder of building.

3.2 Maintenance of Enclosures

.1 Maintain enclosures in tidy condition.

.2 Ensure barriers and polyethylene linings are effectively sealed and taped. Repair damaged barriers and remedy defects immediately upon discovery.

.3 Visually inspect enclosures at beginning of each working period.

3.3 Commence Asbestos Removal or Cleanup Work When

.1 Arrangements have been made for disposal of waste.

.2 Asbestos work areas enclosures and parts of building required to remain in use are effectively segregated. Negative pressure equipment is operating continuously.

.3 Tools, equipment and materials waste receptors are inside enclosure.

.4 Arrangements have been made for work area security.

.5 Signs are displayed in all areas where access to sealed asbestos work areas possible. Signs shall read:

CAUTION
Asbestos Hazard
Area No
Unauthorized Entry
Wear assigned protective equipment
Breathing asbestos dust may cause serious bodily harm.

.6 Proof of notification to MHS has been submitted.

.7 The City's Third Party Inspector has been notified of intention to proceed and has reviewed enclosures and equipment.

3.4 Asbestos Disturbance in Enclosure

.1 Before commencing Work, prepare Site as described in clause 3.1, 3.2 and 3.3.

.2 Seal opening to enclosure with tape after entry of worker. Worker shall remain inside enclosure until disturbed asbestos-containing materials are removed and enclosure has been effectively cleaned.

.3 Perform work required inside enclosure. Trades personnel may enter enclosure to perform Type 2 operations under the guidance of competent worker.

.4 When cleaning or removing asbestos-containing drywall walls within enclosure, spray asbestos-containing material with amended water. Saturate asbestos to prevent release of airborne fibres during removal. Place fully saturated asbestos directly into waste containers.

.5 Treat materials removed including used polyethylene sheeting as asbestos contaminated waste and dispose of as such.

.6 Following completion of work, clean surfaces from which asbestos has been disturbed with HEPA vacuum, or wet-sponge if appropriate to remove all visible material.

.7 Carefully place asbestos waste in inner bag of asbestos waste receptor. Clean inner bag surface of gross contamination and place in clean 6 mil outer bag. If waste is likely to tear inner bag, then instead of outer bag use fibre or metal drum, cardboard or wood box, or other suitably sturdy container.

.8 After wet-sponging or vacuuming to remove visible asbestos, wet clean entire enclosure. Apply coat of sealer to all surfaces from which asbestos has been disturbed. Apply thinned coat (sufficient to coat all surfaces) to interior of polyethylene enclosure prior to tear down.

3.5 Tear Down of Protection

.1 When dismantling enclosure, carefully roll polyethylene toward centre of enclosure. As polyethylene is rolled away, immediately remove any visible debris with HEPA vacuum.

.2 Place polyethylene sheeting seals, tape, cleaning material, coveralls, and other contaminated waste in asbestos waste receptors for transport. Remove any debris fallen behind plastic with HEPA vacuum.

.3 Clean-up asbestos waste receptors and equipment used in work, and remove from asbestos work area(s) via drum and equipment decontamination enclosure systems, at appropriate time in sequence. Double bag waste immediately prior to transport from Site to disposal bin.

.4 Final review may be carried out by Contract Administrator to ensure no dust or debris remains.

3.6 Re-Establishment of Objects and Systems

.1 When clean-up is complete, reinstall items removed to facilitate asbestos related operation, in their proper positions. Reconstruction and reinstallation shall be by tradesmen qualified in work being reinstalled or reconstructed.

.2 For buildings not scheduled for demolition, make good all damage at completion of Work.

3.7 Air Monitoring

.1 Refer to Item 3.12 of Section 02 82 13, Asbestos Abatement – Type 3.

3.8 Inspection

.1 Refer to Item 3.13 of Section 02 82 13, Asbestos Abatement – Type 3.

3.9 Waste Transport and Disposal

.1 Conform to requirements of national and provincial regulations and guidelines related to the transportation and disposal of hazardous waste.

.2 Check with waste disposal facility to determine type of waste containers acceptable.

.3 Waste disposal shall be sent to a disposal facility approved by the City.

.4 Check with waste disposal facility to determine type of waste containers acceptable.

.5 Ensure shipment of containers to waste disposal facility is taken by waste hauler licensed to transport asbestos waste.

.6 Each load requires completion of bill of lading showing type and weight of hazardous waste being transported. Provide copies of bill of lading indicating acceptance of waste at waste disposal facility.

.7 Co-operate with third party inspectors and immediately carry out instructions for remedial work at dump to maintain environment, at no additional cost to the City.

.8 Ensure waste disposal facility is fully aware of hazardous material being dumped.

.9 Ensure that containers used for disposal are locked and covered at all times.

END OF SECTION

ASBESTOS ABATEMENT – TYPE 3

1. GENERAL

1.1 Section Includes

.1 Requirements and procedures for asbestos abatement of Type 3 (High Risk) work related to chrysotile asbestos-containing materials of the type describe within.

1.2 References

.1 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-1.205-2003, Sealer for Application of Asbestos-Fibre Releasing Materials.

.2 Department of Justice Canada (Jus):

.1 Canadian Environmental Protection Act, 1999 (CEPA).

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

.1 Material Safety Data Sheets (MSDS).

.4 The Government of Manitoba, Workplace Safety and Health Division (WSH):

.1 Chapter W210 10/02, The Workplace Safety and Health Act, Manitoba Workplace Safety and Health Act and Regulation, 2015.

.2 Guidelines for Working With Asbestos, 2008 (WSH).

.5 Transport Canada (TC):

.1 Transportation of Dangerous Goods Act, 1992 (TDGA).

.6 Underwriters' Laboratories of Canada (ULC).

.7 City of Winnipeg – Appendix A – Primary Clarifier Asbestos Report.

1.3 Scope of Work

.1 Laws of province of Manitoba shall govern this work. Contractor shall observe all such laws and shall obtain and pay all permits, notices, fees, taxes, duties as may be required. Likewise, it is responsibility of contractor to comply with the *Manitoba Workplace Safety and Health Act and Regulation*.

.2 Comply with requirements of this Section when performing following Work:

.1 Removal of Type 3 asbestos-containing materials as required to complete the Work.

.3 Approximate locations and quantities are provided in Appendix A. These values are for information purposes only. Prior to tender, the Contractor shall be solely responsible to obtain and verify quantities and locations on-site and confirm that all known asbestos-containing materials have been included in the lump sum bid.

.4 Abate, load, transport and dispose of all known hazardous building materials including asbestos, requiring removal to complete the Work, prior to demolition. The City reserves the right to request modifications to the Contractors Abatement Plan as appropriate to meet minimum expectations of safety.

.5 The Contractor shall be responsible for obtaining information regarding the types of materials identified by reviewing and understanding the information provided in the reports and reference drawings, and by reviewing the City Site to confirm and satisfy any assumptions made on the material types and quantities.

.6 Asbestos-containing materials and other designated substances that may be present in areas deemed inaccessible shall be included as a unit price in the Base Bid – Provisional Items to include abatement, loading, transporting and disposing of which will be quantified and paid for by the City for additional asbestos-containing materials or other Designated Substances identified after Third Party Inspector quantification and certification.

.7 The Contractor shall provide a Detailed Abatement Plan that outlines a site and building specific environmental remediation strategy, ensuring all potential hazards and building related environmental impacts are considered during the abatement process. The Detailed Abatement Plan shall include the following:

Abatement Plan Type	**Deliverable Requirement**	**Abatement Plan Requirements**
Detailed Abatement Plan	Issue two weeks after award of work. No document size limit. Provide a table of contents and clearly identify sections by using section dividers	1. In addition to the requirements listed in the accepted Preliminary Abatement Plan listed above, provide additional details related to the proposed abatement methods and procedures. Include drawings and other supporting documents to further define isolation boundaries, equipment work paths, decontamination areas, and overall site operation over the course of the project.
		2. Provide Activity Hazard Analysis (AHA) forms for all abatement work types, including but not limited to: heat stress, cold weather work, confined space entry, aerial lift operation, hot work, cutting, torching, grinding, large equipment use, waste handling, and other varied measures and procedures.
		3. Outline an Emergency Response Plan which shall include all steps to follow in case of an emergency on the removal sites. The plan shall include the way to access, emergency decontaminate, and evacuate the site.

Abatement Plan Type	Deliverable Requirement	Abatement Plan Requirements
		4. Inspection, monitoring and sampling protocols will be designed by the Contract Administrator based on the Preliminary Abatement Plan and will be implemented into the final Abatement Plan upon approval by the Contract Administrator.
		5. The Detailed Abatement Plan will be reviewed by the City, Contract Administrator and the City's Third Party Inspector. and is subject to review by other Stakeholders. No application for extra funds will be entertained by the City for additional costs incurred as associated with plan reviews, plan changes, meetings, revisions, and addition inspection provisions and requirements.

.8 Removal of articles remaining in the Facility at commencement of the work is the responsibility of the Contractor.

.9 Containment, removal, and disposal of materials on the property at commencement of the work is the responsibility of the Contractor. Measures and procedures for dust suppression, worker protection, and waste collection shall be provided to satisfy safety requirements.

.10 Maintain only emergency electrical and mechanical services passing through asbestos work area. All other services must be deactivated during abatement work.

.11 Provide heat, water, and power where necessary to perform the Work.

.12 Provide necessary cranes, lifting devices, scaffolding, elevated work platforms, and safety equipment to adequately complete the work and maintain worker safety. The Contractor shall provide the Contract Adminstrator stamped drawings and approvals for scaffolding and work platforms where required by law and as otherwise specified.

.13 All work will be subject to inspection and air monitoring inside and outside asbestos work area by the City's Contract Administrator. Any contamination of surrounding areas, indicated by visual inspection or air monitoring, shall necessitate complete cleanup of affected areas at no additional cost to the City.

.14 Contractor to erect a project health and safety board. Health and safety board to contain contact information, MSDS's, Safety Policy, AHAs, project specifications, project reports, site specific environmental remediation strategy and action plan, etc.

.15 Notify Manitoba Workplace Safety and Health at least five (5) days prior to beginning abatement work.

.16 Ensure all necessary permits for asbestos abatement work, variance, demolition, etc. are posted at the Site prior to start of Work.

1.4 Definitions

.1 Air Lock: Temporary chamber sealed with polyethylene sheeting; curtained doorways constructed at either end with a minimum of 6 feet (2.0 metres) separation; minimum width is 36 inches (900 mm).

.2 Amended Water: water with non-ionic surfactant wetting agent added to reduce water tension to allow wetting of fibres.

.3 Asbestos-Containing Materials (ACMs):

.1 A friable material containing 0.1% or greater asbestos, including fallen materials and settled dust.

.2 A non-friable material containing 1.0% or greater asbestos, including fallen materials and settled dust.

.4 Asbestos Waste Container: An impermeable container acceptable to the waste disposal facility and regulations. New Materials Only. Labelled as required. Comprised of one of the following:

.1 A 6 mil (0.15 mm) sealed polyethylene bag, inside a second 6 mil (0.15 mm) sealed polyethylene bag.

.2 A 6 mil (0.15 mm) sealed polyethylene bag, positioned inside or outside a rigid sealed container of sufficient strength to prevent perforation of the container during filling, transportation and disposal.

.3 A sealed Glove Bag, inside a 6 mil (0.15 mm) sealed polyethylene bag.

.4 A sealed Glove Bag, inside a rigid sealed container of sufficient strength to prevent perforation of the container during filling, transportation, and disposal.

.5 Asbestos Work Area: Area where work takes place, which will, or may, disturb ACM.

.6 Authorized Visitors: The City, Contract Administrator or the City's Third Party Inspector and persons representing regulatory agencies.

.7 Curtained Doorway: arrangement of closures to allow ingress and egress from one room to another while permitting minimal air movement between rooms, typically constructed as follows:

.1 Place two (2) overlapping sheets of polyethylene over existing or temporarily framed doorway, secure each along top of doorway, secure vertical edge of one sheet long one vertical side of doorway, and secure vertical edge of other sheet along opposite vertical side of doorway.

.2 Reinforce free edges of polyethylene with duct tape and weight bottom edge to ensure proper closing.

.8 DOP Test: A testing method used to determine the integrity of the Negative Pressure unit using dioctyl phthalate (DOP) HEPA filter leak test.

.9 Fitting: Any elbow, valve, tee, reduction, etc. that is present on a pipe system.

.10 Flexible Ducting: Tubing with metal reinforcement or approved equal in accordance with B7; diameter to equal negative air discharge.

.11 Friable Material: Material that when dry can be crumbled, pulverized, or powdered by hand pressure and includes material that is crumbled, pulverized or powdered.

.12 HEPA vacuum: High Efficiency Particulate Air filtered vacuum equipment with filter system capable of collecting and retaining fibres greater than 0.3 microns in any dimension at 99.97% efficiency.

.13 Mechanical Systems: Components that make up a building's plumbing, heating, ventilation, or process systems including but not limited to piping, fittings, vessels, pumps, tanks, ducts, air-handling units, processing equipment, etc.

.14 Milestone Inspection: Inspection of the Asbestos Work Area at defined point in the removal operation.

.15 Negative pressure: system that extracts air directly from work area, filters such extracted air through High Efficiency Particulate Air filtering system, and discharges this air directly outside work area to exterior of building.

.1 System to maintain minimum pressure differential of 5 Pa relative to adjacent areas outside of work areas, be equipped with alarm to warn of system breakdown, and be equipped with negative air pressure device to continuously monitor and automatically record pressure differences.

.16 Negative Pressure Device: Contractor to supply and install electronic Negative Pressure Recorder complete with digital print out for precise real time monitoring of negative pressure levels. Standard of acceptance – Omniguard III by Engineering Solutions Inc., approved equal in accordance with B7.

.17 Occupied Area: Any area of the building outside the Asbestos Work Area.

.18 Personnel: All Contractors' employees, subcontractors employees, supervisors, and authorized visitors.

.19 Polyethylene: Either polyethylene sheeting or rip-proof polyethylene sheeting of 0.15 mm (6 mil) minimum thickness with tape along edges around penetrating objects, over cuts and tears, and elsewhere as required to provide a continuous polyethylene membrane to protect underlying surfaces from water damage or damage by lock-down agents, and to prevent escape of asbestos fibres through sheeting into Occupied Areas.

.20 Type 1 Work: as described in WSH Guideline for Working with Asbestos.

.21 Type 2 Work: as described in WSH Guideline for Working with Asbestos.

.22 Type 3 Work: as described in WSH Guideline for Working with Asbestos.

1.5 Submittals

.1 Prior to Commencing Work:

.1 Site-Specific Health and Safety Plan for the removal of all Hazardous Materials from the Facility.

.2 Preliminary and Detailed Abatement Plan.

.3 Submit proof of Contractor's Asbestos Liability Insurance.

.4 Names and credentials of the:

.1 Overall Asbestos Abatement Superintendent.

.2 Shift Superintendents.

.3 Workers.

.5 Submit proof satisfactory to Asbestos Abatement Monitoring & Inspection Agent that employees have had instruction on hazards of asbestos exposure, respirator use, dress, entry and exit from Asbestos Work Area, and aspects of work procedures and protective measures.

.6 Submit proof that supervisory personnel have attended asbestos abatement course, of not less than two days duration, approved by Asbestos Abatement & Inspection Agent. Minimum of one supervisor for every ten workers. Worker’s Compensation Board status and transcription of insurance.

.7 Documentation including test results, fire and flammability data, and Material Safety Data Sheets for chemicals or material used in the course of the project including but not limited to:

.1 Sealing Agent (Encapsulant).

.2 Wetting Agent.

.3 Lock-down agent.

.4 Rip-proof polyethylene.

.5 Other chemicals or materials proposed for use in the course of the asbestos abatement project.

.8 Submit Provincial and/or local requirements for Notice of Project Form.

.9 Proposed schedule for each phase of the work providing the following for each separate Asbestos Work Area:

.1 Duration of abatement work in each Asbestos Work Area.

.2 Proposed average daily work force.

.3 Milestone inspection dates.

.10 Submit proof satisfactory to Asbestos Abatement Monitoring & Inspection Agent that suitable arrangements have been made to dispose of asbestos-containing waste in accordance with requirements of Authority Having Jurisdiction.

1.6 Regulations

.1 Comply with Federal, Provincial and local requirements including “Manitoba Guidelines for Working With Asbestos.”

.2 The Worker's Compensation Act, Safety Regulations Governing Building, Construction and Demolition.

.3 Workplace Health and Safety Act, (most recent edition).

.4 Contractor shall ensure that:

.1 Measures and procedures prescribed under the Workplace Health and Safety Act are carried out.

.2 Every employee and every worker on project complies with applicable act and regulations.

.3 Health & safety of workers and public is protected.

.4 All material handling and associated equipment conform to and are operated in accordance with "Workplace Hazardous Materials Information System" (WHMIS).

.5 Advise the City whenever work is expected to be hazardous to employees and/or public.

.6 Contractor may be requested to provide information on their health & safety record.

1.7 Supervision

.1 Provide on-site, an Overall Asbestos Superintendent, with authority to oversee all aspects of the work, including but not limited to, estimating and negotiation of changes to the contract, update of submission requirements, scheduling, manpower and equipment requirements, and direct communication and coordination with the City, the Contract Administrator, or the City’s Third Party Inspector.

.2 Provide on-site, in addition to the Overall Asbestos Superintendent, and for each work shift, a Shift Superintendent who has authority regarding all aspects related to manpower, equipment, and production.

.3 Supervisory personnel must hold a recognized certificate proving attendance at an asbestos removal training course (two-day minimum duration) acceptable to the City and have supervised a minimum of five (5) other asbestos abatement/demolition projects in similar size and/or complexity.

.4 The Overall Asbestos Superintendent or the Shift Superintendent must be on site at all times during work that is at risk of disturbing ACM. Failure to comply with this requirement will result in a stoppage of all work, at no cost to the City.

.5 Replace supervisory personnel with approved replacements within three (3) working days of a written request from the City. The City reserves the right to request replacement of supervisory personnel without explanation.

.6 Asbestos Abatement Contractor cannot replace supervisory personnel without written approval from the City.

1.8 Quality Assurance

.1 Ensure work proceeds to schedule, and meets all requirements of this Section. Perform work so that airborne asbestos, asbestos waste, or water runoff do not contaminate areas outside the asbestos work area. The Contract Administrator or Third Party Inspector is empowered to order a shutdown of work when a leak or breech of isolation has occurred or is likely to occur.

.2 Pay cost to the City of inspection and air monitoring performed as result of failure to perform work satisfactorily regarding quality, safety, or schedule.

.3 Use only skilled and qualified workers for all trades required for this work.

.4 All work of this section involving electrical, mechanical, carpentry, glazing, etc. shall be performed by licensed persons experienced and qualified for the work required.

.5 The City, Contract Administrator, or Third Party Inspector will not be responsible for and will not have control or charge of construction means, methods, techniques, sequences or procedures, or for safety precautions and programs required for the work in accordance with the applicable construction safety legislation, other regulations or general construction practice. The City, Contract Administrator or Third Party Inspector will not be responsible for or have control or charge over the acts or omissions of the Asbestos Abatement Contractor, their Subcontractors or their agents, employees, or other persons performing any of the work.

1.9 Worker and Visitor Protection

.1 Instructions: Before entering asbestos work area, instruct workers and visitors in use of respirators, dress, showers, entry and exit from asbestos work areas, and all aspects of work procedures and protective measures. Instruction shall also include training in hazards of asbestos exposure and be provided by a person who is trained to competently perform this task.

.2 Full Face Respirator: During wet removal and cleanup in enclosed asbestos work area workers, supervisors, and authorized visitors shall be supplied with and use powered air-purifying full-face respirator (PAPR) with N-100, R-100 or P-100 filters. Replace filters daily or test according to manufacturer's specifications and replace as indicated. Provide proper instruction to workers and visitors in use of respirators, cleaning, inspection, and storage and ensure all personnel and visitors are fit-tested using qualitative and/or quantitative techniques. Maintain respiratory protection equipment in proper functioning and clean condition.

.3 Protective Clothing: Provide workers and visitors in full-enclosure sites with full body coveralls with integral hoods. Once coveralls are worn in asbestos work area, dispose of as

contaminated waste. Workers and visitors shall wear other protective apparel required by regulations, including but not limited to: hard hats, safety shoes, and hearing protection.

.4 Before entering asbestos work area(s) remove street clothes in clean change room and put on respirator with new or tested filters, clean coveralls and head covers before entering equipment and access areas or asbestos work area. Store street clothes, uncontaminated footwear, towels etc. in clean change room.

.5 Persons leaving asbestos work area(s) shall remove gross contamination from clothing before leaving asbestos work area. Proceed to equipment and access area and remove all clothing except respirator. Place contaminated work suit in receptacles for disposal with other asbestos contaminated materials. Footwear, clothing, hardhats, protective eyewear, etc., shall be left in equipment and access area to dry for later use. Still wearing respirator proceed naked to showers. Clean respirator to ensure that visible contamination is removed. After having thoroughly washed hair and body with shampoo and soap, remove respirator. Remove filters and dispose of in container provided for this purpose or test filters according to manufacturer's recommendation. Dispose of filters as necessary. Wet clean inside of respirator. Upon completion of asbestos abatement, dispose of footwear as contaminated waste or clean before removing from equipment and access area, or carry in sealed plastic bag to next site.

.6 Following showering, proceed to clean change room, dry off and dress in street clothes. Store respirators in fashion to allow them to be put on prior to entering asbestos work area at start of next shift without contaminating clean area. If re-entry to asbestos work area is to take place after having left for eating or drinking, follow procedures in item 1.9 D.

.7 Removal of waste and equipment from holding room of waste decontamination enclosure system shall be performed by workers entering from outside. These workers shall wear clean coveralls and half-face, asbestos approved, respirator as specified in clause 1.9.2 and 1.9.3. No worker shall use this system as means to leave or enter asbestos work area.

.8 Do not eat, drink, smoke or chew gum or tobacco except in established locations outside the Asbestos Work Area.

.9 Workers and visitors shall be fully protected as specified herein when possibility of disturbance of asbestos exists.

.10 Compressed air shall not be used to clean up or remove dust from any surface.

2. PRODUCTS

2.1 Materials

.1 Polyethylene: 0.15 mm (6 mil) minimum thickness unless otherwise specified.

.2 Rip-Proof Polyethylene: 0.20 mm (8 mil) fabric made up from 0.13 mm (5 mil weave and two (2) layers 0.04 mm (1.5 mil).

.3 Tape: Tape suitable for sealing polyethylene to surface encountered, under both wet conditions using amended water, and dry conditions.

.4 Wetting Agent: Non-foaming surface active agent; mixed with water in concentration to provide thorough wetting of asbestos fibre: Standard of Acceptance, Asbesto-Wet, distributed by Asbetec Distributors, approved equal in accordance with B7.

.5 Amended Water: Water with wetting agent added.

.6 Asbestos Waste Receptors: Two separate containers of which 1 shall consist of 0.15 mm (true 6 mil) minimum thickness sealable polyethylene bag. Other container may be 0.15 mm (true 6 mil) minimum thickness polyethylene bag. Outer container shall be adequate to prevent perforating rips, or tears during filling, transport or disposal. Containers must be acceptable to disposal facility selected, and MHS, and shall be clearly marked to indicate that contents contain asbestos.

.7 Slow - drying sealer: non-staining, clear, water - dispersible type that remains tacky on surface for at least eight (8) hours and designed for purpose of trapping residual asbestos fibres.

.1 Sealer: flame spread and smoke developed rating less than 5.

.8 HEPA Vacuum: Vacuum with all necessary fittings, tools and attachments. Air must pass HEPA filter before discharge.

.9 Protective Coveralls: Disposable full body coveralls complete with elasticized hoods made of spun polyolefin material Tyvek by Dupont or nonwoven material by Kleenguard.

.10 Encapsulant: Serpiflex Shield or approved equal in accordance with B7 upon approval from Contract Administrator.

3. EXECUTION

3.1 Preparation

.1 Full-enclosure Asbestos Work Area(s):

.1 The Contractor is responsible to move all equipment, tools, furnishings, and stored materials without disturbing asbestos-containing materials.

.2 Deactivate air handling and ventilation systems supplying or exhausting from asbestos work area(s). Schedule this shut-down with Contract Administrator and the City.

.3 All wall and horizontal surfaces not scheduled for demolition and removal shall be pre-cleaned using damp cloth or sponge techniques prior to placement of polyethylene sheeting to any wall or floor surfaces. HEPA equipped vacuum cleaners may also be used to perform this task.

.4 If necessary, caulk and seal ducts and duct shafts to remain in service as required, to make airtight. Cut and cap supply ducts with rigid sheet metal caps and seal. Perform work at appropriate time under contaminated conditions if necessary.

.5 Seal off openings such as doorways, windows, vents, service holes in walls and grilles to non-operating ducts with polyethylene sheeting with tape or with polyurethane foam as appropriate.

.6 Cover wall and floor surfaces not scheduled for demolition and removal with polyethylene sheeting sealed with tape. Provide two separately sealed layers of reinforced polyethylene sheeting. Separately seal floor drains or openings. Use sufficient layers (two) and necessary sheathing for walking surface to protect floors which may be damaged. Cover floors first so that polyethylene extends at least 300 mm (12 inches) up walls then cover walls to overlap floor sheeting. Provide additional protection for floors likely to be damaged by amended water, by covering floor with rip-proof polyethylene sheeting sealed with tape.

.7 Cover with polyethylene sheeting, motors, heating units, fire apparatus, door closers, benches, shelving, storage racks, valves, taps, controllers, lights, and other fixtures and furnishings which are not being removed from asbestos work area and which could be damaged and/or which cannot be readily cleaned at completion of this work. Pre-clean surfaces potentially contaminated with asbestos, with HEPA vacuum or damp cloth prior to installing protection.

.8 Install plywood enclosures, covered with rip-proof polyethylene sheeting to protect equipment or fixtures scheduled to be salvaged in asbestos work area(s) that may be damaged.

.9 Establish negative pressure in asbestos work areas in buildings not scheduled for demolition and removal. Volume of air shall be sufficient to ensure airflow is maintained from clean areas into asbestos work area. Vent units to outside of building by removing, and later replacing, windows, and/or providing flexible ducting. Locate vents to discharge air away from building access points or sidewalks. Do not discharge air into building interior. Leak test negative air units prior to commencement of abatement at operating position, using DOP method. Provide reports for unit efficiency test results within 48 hours of testing, including calibration certificates for testing equipment. Venting of exhaust air through occupied area shall be in rigid airtight ductwork. Operate negative pressure units continuously from this time until completion of final air monitoring. Replace pre-filters as necessary to maintain airflow. Maintain negative air pressure of 5 Pascal (-0.02 inches water column) pressure reduction within asbestos enclosure with respect to surrounding areas.

.10 Negative pressure to be measured with a device at regular intervals. Measurements to be posted on health and safety board on a daily basis.

.11 Where required, remove and replace windows for the exhausting of negative air units for each Type 3 work area.

.12 Maintain emergency and fire exits from asbestos work area, or establish alternative exits satisfactory to Authorities Having Jurisdiction.

.13 Ensure existing power supply to asbestos work area is isolated and disconnected where necessary. Provide ground fault electrical system where application of amended water is required for wetting asbestos-containing materials. Supply all electrical apparatus from this ground fault system. Ensure safe installation of electrical lines and equipment.

.14 Provide temporary lighting in asbestos work area to levels that will permit work to be done safely and well.

.15 Provide fire extinguisher at each emergency exit, and in decontamination facilities. Protect extinguishers with polyethylene sheeting in manner that will not hamper emergency use.

3.2 Workers' Decontamination Enclosure System

.1 Construct workers' decontamination enclosure at entrance to each asbestos work area. Worker decontamination enclosure system shall comprise three interconnecting rooms as listed in clause 3.2.2, 3.3.3, and 3.2.4. Provide a set of curtain doorways between each room, and at both dirty and clean entrances to enclosure systems.

.2 Equipment and Access Room: Build room between shower room and asbestos work area. Install waste receptor, and storage facilities for worker's shoes and any protective clothing to be reworn in asbestos work areas. Equipment and access room shall be large enough to accommodate specified facilities, and other equipment needed, and at least one worker allowing sufficient space to undress comfortably. Minimum size 3 square metres (30 sq. ft.).

.3 Shower Room: Build room between clean room and equipment and access room. Provide constant separate supplies of hot and cold water. Provide valves controllable at shower(s) to regulate water temperature. Provide rigid piping with watertight connections and connect to water sources and drains. Provide soap, clean towels and appropriate containers for disposal of used respirator filters. Direct wastewater to sanitary sewer drains or temporary holding tanks via water filtering system consisting of a minimum two-stage filtering system (25-micron and 5-micron filters).

.4 Clean Room: Build room between shower room and clean areas outside of enclosures. At doorway to clean room, provide vented wood door, with locking passage set. Provide hangers for workers' street clothes and personal belongings. Provide storage for clean protective clothing and respiratory equipment. Install water heater, if required.

3.3 Waste and Equipment Decontamination Enclosure System

.1 Construct system comprised of three linked rooms: Purpose of this system is to provide means to decontaminate drums, scaffolding, material containers, vacuum and spray equipment; and other tools and equipment for which worker decontamination system is not suitable. Provide curtain doorways between rooms, and at both dirty and clean entrances to Enclosure System.

.2 Staging Area: Build staging area in asbestos work area for gross removal of dust and debris from waste containers and equipment, labeling and sealing of waste containers, and temporary storage pending removal to container cleaning room.

.3 Container Cleaning Room: Build container cleaning room between staging area and holding room. Room shall be of sufficient size to allow proper washing of equipment and drums or double bagging of asbestos waste. Treat wash water as asbestos contaminated waste.

.4 Holding Room: Build holding room between container cleaning room and uncontaminated area. Holding room shall be of sufficient size to accommodate largest item of equipment used and ten waste containers.

3.4 Construction of Decontamination Enclosures

.1 Floor: Prior to erecting wall framing, lay 1 sheet of rip-proof polyethylene sheeting over floor area to be covered by enclosures. Turn 600 mm (24 inches) of rip-proof polyethylene sheeting up outside of enclosure, overlapping with polyethylene sheeting covering perimeter walls. Provide second layer of rip-proof polyethylene sheeting to all floors, extending 600 mm up inside of enclosure walls.

.2 Walls: Build load-bearing walls of 39 mm x 89 mm (2 inches by 4 inches) wood framing, 400 mm (16 inches) o.c. with continuous top and sill plates. Cover both sides walls with polyethylene sheeting. Walls exposed to asbestos work area shall be covered with min. 9 mm (3/8 inches) plywood sheeting or hardboard. Caulk seal and tape plywood joints. Walls exposed to occupied area shall be covered with good one side 9 mm plywood.

.3 Roof: Size of joists shall be determined by span, loads, use and Code. Use as a minimum 39 mm by 138 mm (2 inches by 6 inches) joists. Cover joists with 19 mm (3/4 inches) plywood sheeting. Seal and tape joints, and cover with two layers of rip-proof polyethylene sheeting. At underside of joists install one layer of polyethylene sheeting.

.4 Doorways: Build curtain doorways designed so that when workers or drums and equipment move through doorway, one of two barriers comprising doorway always remains closed.

3.5 Maintenance of Enclosures

.1 Maintain enclosures in tidy condition.

.2 Ensure barriers and polyethylene sheeting linings are effectively sealed and taped. Repair damaged barriers and remedy defects immediately upon discovery.

.3 Visually inspect enclosures at beginning and end of each working period.

3.6 Do Not Commence Asbestos Removal Work Until

.1 Arrangements have been made for disposal of waste.

.2 Asbestos work areas and decontamination enclosures are effectively segregated. Negative pressure equipment is operating continuously.

.3 Tools, equipment and waste materials receptors are on hand.

.4 Arrangements have been made with the City's Third Party Inspector for work area security.

.5 Signs are displayed in areas where access to sealed asbestos work area is possible. Signs shall read:

CAUTION
Asbestos Hazard
Area No
Unauthorized Entry
Wear assigned protective equipment
Breathing asbestos dust may cause serious bodily harm

.6 Proof of notification to MHS has been submitted.

.7 The City's Third Party Inspector has been notified of intention to proceed and has reviewed enclosures, equipment and procedures.

3.7 Contaminated Preparation for Full-Enclosure Asbestos Work Area

.1 Before performing any contaminated work, prepare Site as described in clause 3.1, 3.2, 3.3, 3.4, 3.5, and 3.6.

.2 Where required, using full protective procedures including amended water and HEPA vacuum, install upper seals as necessary to allow polyethylene sheeting to be fastened to structure. Each of two sheets forming wall of enclosure shall be fastened separately to deck using tape, spray adhesive, rapid setting foam or other suitable method. Provide suitable framing to support polyethylene sheeting. Seal holes in existing perimeter walls, columns, deck etc., to ensure an airtight asbestos work area.

.3 Promptly seal holes or penetrations in structure above ceiling, ducts, etc. to provide airtight enclosure around asbestos work area(s).

.4 Protect electrical, communication, life safety and control systems to remain in place in asbestos work area with polyethylene sheeting. Seal joints and holes in un-insulated HVAC ductwork to remain operational through an asbestos work area, using tape and rip-proof polyethylene sheeting.

3.8 Removal

.1 In areas of wet removal of spray or trowel applied material, spray asbestos with amended water using airless spray equipment. Saturate asbestos to substrate to prevent release of airborne fibres during removal. Fully saturated asbestos may be scraped directly into waste containers or may be allowed to fall to floor.

.2 Remove, under contaminated conditions, bulkheads and non-load bearing walls necessary to allow complete removal of friable asbestos. Remove all or parts of walls sufficiently to remove asbestos within wall or enclosure.

.3 Any replacement of blocks, bricks or other masonry removed to allow access to asbestos shall be replaced by the Contractor. Clean and seal seams and openings in surface of ducts prior to disposal.

.4 Remove asbestos-containing pipe and fitting insulation in layers, while maintaining all exposed surfaces of insulation or lagging in wet condition. Full saturation of insulation will not be required if material is immediately bagged and not allowed to fall to floor.

.5 Seal ends of pipe and duct insulation at perimeters of asbestos work area with heavy coat of high temperature sealer.

.6 Place asbestos waste in asbestos waste receptors. If drums are used for waste disposal, drums shall be sealed and cleaned in waste decontamination enclosures. If double plastic bags are used, inner bag shall be cleaned of gross contamination and placed in a clean 6 mil outer plastic bag in container cleaning room immediately prior to transfer from Site.

.7 Treat all materials removed to expose asbestos, as asbestos-contaminated waste unless such materials are specified to be reused.

3.9 Clean-Up

.1 Clean surfaces with brushes and vacuum or wet-sponge to remove visible dust and debris.

.2 Remove sealed and labelled asbestos waste receptors and dispose of in authorized disposal area in accordance with requirements of disposal authority.

.3 After brushing and wet-sponging to remove visible asbestos, wet clean entire asbestos work area including equipment and access area, polyethylene sheeting and equipment used in process. Floor and wall surfaces, ducts, and similar items not covered with polyethylene sheeting must be wet cleaned.

.4 Request visual inspection and acceptance. Following inspection and acceptance, apply heavy coat of slow drying sealer to all surfaces from which asbestos has been removed. Apply thinned coat (sufficient to coat all surfaces) to other surfaces in asbestos work area including all polyethylene sheeting and surfaces scheduled for demolition. Allow minimum of twelve (12) hours flushing time with no disturbance of asbestos work area. Operate negative air units during this period for buildings scheduled to remain in place.

3.10 Dismantling of Protection

.1 Following cleaning specified in above, and when air sampling shows that asbestos levels on both sides of seals do not exceed 0.01 fibres/cc as determined by membrane filter method at 400-500X magnification phase contrast illumination, as described in NIOSH 94-113 approved equal in accordance with B7, proceed with final clean-up.

.2 Remove polyethylene sheeting exposed during contaminated work including upper surfaces plus any underlying sheeting contaminated by water leaks, rips, tears, or exposed by failure of upper layer. Wear half face piece respirator and disposable coveralls during removal of sheeting. Carefully roll sheeting away from walls to centre of asbestos work area. As sheeting is rolled away from walls and corners, HEPA vacuum visible debris.

.3 While removing top layer of sheeting from surfaces protected by two layers of sheeting, cut lower sheeting so as to expose horizontal surfaces that may be contaminated with asbestos debris. HEPA vacuum any visible debris.

.4 Place polyethylene sheeting, seals, tape, cleaning material, clothing, and other contaminated waste in asbestos waste receptors for transport. Remove with HEPA vacuum any debris which may have fallen behind sheeting.

.5 Clean asbestos work area(s), equipment and access area, washing/showering room, and other enclosures that may have been contaminated during work.

.6 Clean asbestos waste receptors and equipment used in work and remove from asbestos work area(s) via drum and equipment decontamination enclosure system, at an appropriate time in sequence.

.7 Remove hoardings, temporary lighting, equipment and facilities provided for work. A final review may be carried out by the City's Third Party Inspector to ensure that no dust or debris

remains. Asbestos abatement contractor responsible for inspecting and cleaning all adjacent spaces to the asbestos abatement work area. Adjacent work areas to be left free of construction related dust and debris.

3.11 Re-Establishment of Objects and Systems

.1 When cleanup is complete re-establish mechanical and electrical systems to remain operative in proper working order, where required. Arrange for, and pay costs of electrical or mechanical repairs needed due to work of this Section.

.2 For buildings not scheduled for demolition, make good all damage at completion of work.

3.12 Air Monitoring

.1 The City's Third Party Inspector will arrange for air samples to be taken from commencement of work until completion of cleaning operations, both inside and outside of asbestos work area(s) enclosures in accordance with NIOSH methods.

.2 Air monitoring will be performed using Phase Contrast Microscopy (PCM) following the NIOSH method 7400.

.3 Co-operate with the Asbestos Abatement Contractor in collection of air samples, including providing workers to wear sampling pumps for up to full-shift periods. Asbestos Abatement Contractors forces must exercise care with Asbestos Abatement Contractor's equipment. The City reserves the right to back charge the Contractor for re-sampling of samples damaged by tampering or abuse. In addition, the Contractor will be responsible for the cost of testing equipment repairs resulting from the actions of the Contractor's forces.

.4 If air monitoring or visual inspection shows that areas outside current asbestos work area(s) enclosure or decontamination facilities are contaminated above 0.01 fibre/cc., clean these areas in same manner as that applicable to asbestos work areas, at no cost to the City. The area will be considered contaminated until visually inspected and air monitoring results are less than 0.01 fibres/cc.

.5 If air monitoring in work areas shows airborne fibre levels exceed normal levels for wet removal, workers shall use positive pressure supplied air respirators with full-face piece.

.6 If final air sampling by the City's Contract Administrator shows that levels in completed asbestos work area do not exceed 0.01 fibres/cc. as determined by NIOSH 7400 Method - "A" counting rules, proceed with dismantling of enclosures.

.7 Clearance level is < 0.01 f/cc. Clearance sampling will only be conducted in structures scheduled to remain in place or as directed by the City.

3.13 Inspection

.1 From commencement of work until completion of clean-up operations, the City's Third Party Inspector will be present on a part-time basis.

.2 Be fully responsible for coordination of all Work.

.3 Provide access to the Inspector to carry out necessary reviews/inspections:

.1 After the abatement work has been completed, the work shall be inspected by a City's Inspector. Any discrepancies found shall be reported in writing. Contractor shall rectify discrepancies identified before proceeding.

.4 The following Milestone Inspections will take place at Contractor's cost:

.1 Milestone Inspection A – Clean Site Preparation: Inspection of preparations and set-up prior to contaminated work in the Asbestos Work Area.

.2 Milestone Inspection B – Contaminated Perimeter Preparation: Inspection of preparations at perimeter of Asbestos Work Area.

.3 Milestone Inspection C – Before Bulk Removal: Inspection of Asbestos Work Area prior to start of major ACM removal.

.4 Milestone Inspection D – Visual Clearance: Inspection of Asbestos Work Area after removal of all asbestos but prior to application of lock-down agent.

.5 Milestone Inspection E – Air Monitoring Clearance: Inspection and air monitoring after the application of lock-down agent but prior to removal of polyethylene from within the Asbestos Work Area.

.6 Milestone Inspection F – Dismantling Inspection: Inspection after removal of polyethylene prior to dismantling perimeter seal and decontamination facility.

.5 In addition to the Milestone Inspections, inspection of the Asbestos Work Area will be performed to confirm the Asbestos Abatement Contractor's compliance with the requirements of the specification and governing authorities. Any deviations from these requirements, which have not been approved in writing, may result in a stoppage of work, at no additional cost to the City.

.6 The Asbestos Abatement Contractor is empowered by the City to inspect adherence to specified procedures and materials, and to inspect for final cleanliness and completion. Additional labour or materials expended by the Asbestos Abatement Contractor to provide satisfactory performance to the level specified should be at no additional cost.

.7 If the Asbestos Work Area is found unacceptable by the standards specified or required by governing authorities, the work required to meet the standards and obtain consent to proceed from the Asbestos Abatement Contractor, shall be performed at no additional cost to the City.

.8 The Asbestos Abatement Contractor is empowered by the City to order a shutdown of work when a leakage of asbestos from the controlled Asbestos Work Area has occurred or is likely to occur. These conditions include, but are not limited to, failure of negative pressure systems, inadequate wetting, failure of the perimeter enclosure, water leaks, etc. Additional labour or materials to rectify these or other unsatisfactory conditions shall be at no cost to the City.

.9 Pay cost to provide re-inspection of work found not to be in accordance with these specifications and requirements of Authorities Having Jurisdiction.

.10 Inspection and air monitoring performed as a result of Asbestos Abatement Contractor's failure to perform satisfactorily regarding quality, safety, or schedule shall be back-charged to the Contractor.

3.14 Waste Transport and Disposal

.1 Conform to requirements of national and provincial regulations and guidelines related to the transportation and disposal of hazardous waste.

.2 Check with waste disposal facility to determine type of waste containers acceptable.

.3 Waste disposal shall be sent to a City approved disposal facility.

.4 Ensure shipment of containers to dump is taken by waste hauler licensed to transport asbestos waste.

.5 Each load requires completion of bill of lading showing type and weight of hazardous waste being transported. Provide copies of bill of lading indicating acceptance of waste at waste disposal facility.

.6 Co-operate with provincial inspectors and immediately carry out instructions for remedial work at dump to maintain environment, at no additional cost to the City.

.7 Ensure waste disposal facility is fully aware of hazardous material being disposed.

.8 Ensure that containers used for disposal are locked and covered at all times.

END OF SECTION

1. GENERAL

1.1 Work Included

.1 Engineering design for formwork.

.2 Wood and/or steel forms for all cast-in-place concrete, shoring, bracing, and anchorage.

.3 Form openings for other trades.

.4 Coordinate installation of concrete accessories.

.5 Set anchor rods, anchors, sleeves, frames, and other items supplied by other Division within Contract.

.6 Clean erected formwork prior to concrete placement.

.7 Remove forms and supporting falsework.

.8 Void forms between structural elements and the soil below where indicated.

.9 Reshoring.

1.2 Design Standards

.1 Design and detail forms and supporting falsework in accordance with the NBC of Canada 2010 with the Manitoba amendment, and the current editions of CSA A23.1, CSA S269.1, CAN/CSA-S269.3, ACI 347, ACI 347.2R, and applicable construction safety regulations.

.2 Design of the formwork, falsework, and reshoring shall be performed by a Professional Engineer registered in the Province of Manitoba. The Contractor's Engineer doing the design shall review the in-place formwork, falsework and reshoring and certify in writing that the Work is in conformance with her/his design.

1.3 Quality Assurance

.1 Construct and erect concrete formwork in accordance with CSA A23.1, CSA-S269.3, ACI 347, ACI 347.2R and all applicable construction safety regulations for the place of Work.

1.4 Shop Drawings

.1 Submit Shop Drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Clearly indicate sizes, methods of construction, materials, arrangement of joints, ties and shores, location and size of falsework, schedule of erection and stripping, reshoring, etc.

.3 Shop Drawings and design briefs are to bear the seal of a Professional Engineer registered in the Province of Manitoba.

.1 The Shop Drawings shall indicate the Contractor proposed construction joint locations and concrete casting sequence.

.2 Adjust the Contractor proposed construction joints as directed by the Contract Administrator at no additional cost to the City.

.4 Formwork, falsework, and reshoring are to be reviewed prior to each concrete casting by the same Professional Engineer who sealed the Shop Drawings.

.5 The Contractor's Professional Engineer is to report, in writing to the Contract Administrator that reviewed formwork, falsework, and reshoring are in accordance with the design, prior to each concrete casting.

2. PRODUCTS

2.1 Exposed Surfaces

.1 Square-edged, smooth-surfaced panels true in plane, free of holes, surface markings, or defects.

2.2 Unexposed Surfaces

.1 Square-edged tongue and groove lumber, plywood or other material, suitable to retain concrete without leakage or distortion.

2.3 Wood Materials

.1 Plywood: Douglas fir, conforming to CSA O121 solid one side, sheathing grade. Sound undamaged sheets with clean true edges.

.2 Lumber: conforming to CAN/CSA-O141.

.3 Nails, spikes, and staples: galvanized; in accordance with CSA O86.

2.4 Prefabricated Forms

.1 Steel type: minimum 1.6 mm steel thickness; well matched, tight fitting and adequately stiffened to support weight of concrete without deflection detrimental to structural tolerances and appearance of finished concrete surface.

.2 Void forms: the void form shall leave a complete void below the structural element for the full depth indicated on the Drawings. Acceptable product is:

.1 Moisture-resistant treated paper faces; bio-degradable, structurally sufficient to support weight of wet concrete mix and construction loads until initial concrete set.

2.5 Accessories

.1 Form ties: removable snap-off metal type, fixed length, minimum working strength of 13 kN when assembled; free of defects that will leave holes deeper than 25 mm from concrete surface. Use plastic cone snap type or screw type on exposed surfaces. Wire ties are not permitted.

.2 Form release agent: colourless mineral oil that will not stain concrete or impair natural bonding or colour characteristics of coating intended for use on concrete.

.3 Corner or chamfer fillets: mill finished pine, 25 mm width, maximum possible lengths, mitre ends.

.4 Sealing tape: reinforced, self-adhesive, waterproof Kraft.

.5 Galvanizing for steel nails and fasteners: conforming to ASTM A-153/A-153M.

3. EXECUTION

3.1 Examination

.1 Before starting this Work, examine all Work done by others that affects this Work.

.2 Notify the Contract Administrator of any conditions that would prejudice proper completion of this Work.

.3 Prior to the erection of the formwork, all construction joints in the immediate area shall be sand blasted and cleaned in accordance with Section 03 30 00 – Cast-in-Place Concrete.

.4 Commencement of the Work implies acceptance of existing conditions.

3.2 Erection

.1 Verify lines, levels, and centers before proceeding with formwork. Ensure dimensions agree with Drawings.

.2 Construct formwork and falsework to meet design and regulatory requirements, and to produce finished concrete conforming to surfaces, shapes, lines, and dimensions indicated on Drawings.

.3 Arrange and assemble formwork to permit removal without damage to concrete.

.4 Align joints and make watertight, to prevent leakage of cement paste and disfiguration of concrete. Keep form joints to a minimum. Tape joints as necessary.

.5 Arrange forms to allow removal without removal of principal shores, where these are required to remain in place.

.6 Obtain the Contract Administrator’s acceptance before framing openings in concrete slabs, beams, walls, and columns not indicated on Drawings.

.7 Provide falsework to ensure stability of formwork. Prop or strengthen all previously constructed parts liable to be overstressed by construction loads.

.8 Position form joints to suit any expressed lines required in exposed concrete.

.9 Provide chamfer on all external corners and fillets on all internal corners and edges of exposed concrete unless shown otherwise.

.10 Form chases, slots, openings, drips, and recesses if detailed on the Drawings.

.11 Set screeds with top edge level to required elevations.

.12 Check and re-adjust formwork to required lines and levels during placing of concrete.

.13 Where construction joints are required in beams and suspended slabs, form joints at the one third point in the span unless shown or noted otherwise on Drawings.

3.3 Tolerance

.1 Construct formwork to produce concrete with dimensions, lines, and levels shown on the Drawings.

.2 Forms shall be constructed to meet the requirements for shape, dimensions, and tolerances specified in CSA A23.1, Clause 6.4 - Construction Tolerances for Cast-In-Place Concrete.

.3 Tolerances are not cumulative.

.4 Costs for remediation of the formwork shall be borne by the Contractor.

3.4 Inserts/Embedded Items/Openings

.1 Provide formed openings where required for pipes, conduits, sleeves, and other work to be embedded in and passing through concrete members.

.2 Accurately locate and set in place items that are to be cast directly into concrete. Ensure to secure all items from movement during concrete pour. Puddle in method will not be allowed.

.3 Coordinate Work of other Sections and Divisions and cooperate with trades involved in forming openings, slots, recesses, chases, and setting sleeves, bolts, anchors, and other inserts.

.4 Coordinate installation of concrete accessories as specified in Section 03 15 00 – Concrete Accessories.

.5 Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

.6 Close temporary ports or openings with tight fitting panels, flush with inside face of forms, neatly fitted so no leakage occurs and to provide uniform surface on exposed concrete.

3.5 Field Quality Control

.1 Inspect and check complete formwork, falsework, shoring, and bracing to ensure that Work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and parts are secure.

.2 Ensure the Contractor’s Professional Engineer responsible for the formwork, falsework, and re-shoring design reviews the work prior to each concrete casting. Provide written confirmation from the Contractor’s Professional Engineer that she/he has reviewed the formwork and conforms to the design.

.3 Inform the Contract Administrator when formwork is complete and has been cleaned, to allow for review. The Contract Administrator’s review will be for verification that earth bottoms are clean, and that forms are clean and free from debris.

.4 Allow the Contract Administrator to review each section of formwork prior to re-use. Formwork may be re-used if acceptable to the Contract Administrator. Re-use of forms shall be subject to the requirements of CSA A23.1.

3.6 Cleaning

.1 Clean formwork in accordance with CSA A23.1. Clean forms as erection proceeds to remove foreign matter. Remove cuttings, shavings, and debris from within forms. Flush completely with water to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

.2 During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out completed forms, unless formwork and concrete construction proceed within a heated enclosure. Use compressed air or other means to remove foreign matter.

3.7 Formwork Preparation

.1 Apply form release agent in accordance with Manufacturer's recommendations, prior to placing reinforcing steel, anchoring devices, and embedded parts.

.2 Do not apply form release agent where concrete surfaces are to receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces moist prior to placing concrete.

3.8 Form Removal

.1 Notify the Contract Administrator prior to removing formwork.

.2 Do not remove forms and falsework until concrete has gained either sufficient strength to carry its own weight, plus construction loads and design loads that are liable to be imposed or 75% of design compressive strength, whichever is greater. Verify strength of concrete by field cured compression tests to satisfaction of Contract Administrator. Re-shore the concrete structure as directed by the Contract Administrator.

.3 Remove falsework progressively, in accordance with regulatory requirements and ensure that no shock loads or imbalanced loads are imposed on structure.

.4 Loosen forms carefully without damaging concrete surfaces. Do not apply tools to exposed concrete surfaces.

.5 Leave forms loosely in place for protection until curing requirements are complete.

END OF SECTION

CONCRETE ACCESSORIES

1. GENERAL

1.1 Work Included

.1 Expansion Joint Filler.

.2 Joint sealants.

.3 Backer rods.

.4 Polyvinyl Chloride (PVC) Waterstop.

.5 Expansive Waterstop

.6 Non-ferrous grout.

.7 Latex patching agent.

.8 Epoxy bonding agent.

.9 Anchoring adhesive.

.10 Curing and sealing compounds.

.11 Moisture retention film.

.12 Repair mortar.

.13 Epoxy injection system.

.14 Penetrating sealer.

1.2 Qualifications

.1 All sealant and waterstopping installations are to be done by established firm having at least five (5) years of proven, satisfactory experience in these trades and employing skilled personnel.

.2 Epoxy injection installations are to be done by an established firm having at least five (5) years of proven, satisfactory experience in this trade and employing skilled personnel.

.3 Submit proof of qualifications in writing to the Contract Administrator prior to commencement of Work for approval. If firm is deemed to be unqualified, Contractor to employ approved firm at no extra cost.

1.3 Shop Drawings

.1 Submit Product Data in accordance with Section 01 33 00 – Submittal Procedures.

1.4 Maintenance Data

.1 Provide operation and maintenance data for each exposed sealant for incorporation into maintenance manual specified in Section 01 78 00 – Closeout Submittals.

2. PRODUCTS

2.1 Materials

.1 Pre-moulded expansion joint filler (for joints associated with slabs on grade such as pads at doors): asphalt impregnated vegetable or cane fibreboard, conforming to ASTM D1751, sizes indicated on Drawings. Acceptable products: W. R. Meadows Sealtight Fibre Expansion Joint Filler complete with Snap-Cap and Sealtight #164, Hi-Spec, Cold Applied SOF-Seal sealant, Fosroc Fibreboard complete with Pliastic or Colpor 200PF sealant, or approved equal in accordance with B7.

.2 Sealants:

.1 Joint sealants for non-liquid-retaining areas - interior saw cut joint: Dow Corning No. 795 or approved equal in accordance with B7. Provide custom colour(s) for control joint sealant and colour is to match paint for concrete block. Provide Limestone colour for saw cut joints.

.2 Joint sealants for non-liquid-retaining areas - exterior saw cut joints: Dow Corning No. 795. Provide Limestone colour for saw cut joints or approved equal in accordance with B7.

.3 Primers: as recommended and supplied by sealant Manufacturer.

.4 Backer rod: closed cell vinyl foam.

.5 PVC waterstop: to conform to CGSB 41-GP-35M Polyvinyl Chloride Waterstop, edges wire looped for tying. Acceptable product is Paul Murphy Wirestop CR-6380. Factory fabricated and tested PVC waterstop vertical and horizontal cross, L, and T shaped junction sections or approved equal are to be used.

.6 Expansive waterstop: SikaSwell S-2 by Sika Canada or approved equal to be used if specific locations are indicated on the Drawings or as directed by the Contract Administrator.

.7 Non-ferrous grout: pre-mixed, non-shrink, Master Builders 713, Sika Canada Sika M-Bed, CPD Non Shrink Grout, Steel C1 Grout or approved equal in accordance with B7, minimum 35 MPa compressive strength.

.8 Anchoring adhesive at and above the Main Floor elevation: Hilti HIT HY-200 Adhesive or approved equal in accordance with B7. Utilize Hilti HIT-ICE or approved equal in accordance with B7 for cold weather applications.

.9 Moisture retention film: Master Builders Confilm, Sika Canada Sika Film, TK Products Tri Film or approved equal in accordance with B7.

.10 Repair mortar:

.1 Horizontal area not exposed to view: Sika Canada SikaTop 122 Plus or approved equal in accordance with B7.

.2 Vertical area not exposed to view: Sika Canada SikaTop 123 Plus or approved equal in accordance with B7.

.3 Exposed to view: W. R. Meadows Meadow-Crete H or approved equal in accordance with B7.

.11 Epoxy injection system: Specton Flex F1000 or approved equal in accordance with B7. Water Activated Polyurethane Urethane Grout.

3. EXECUTION

3.1 Examination

.1 Before starting this Work, examine all Work done by other Division within Contract.

.2 Notify the Contract Administrator of any conditions that would prejudice proper completion of this Work.

.3 Commencement of Work implies acceptance of existing conditions.

.4 The Contract Administrator, at his discretion may complete isolated destructive testing of the in-place sealants. Contractor is to remediate areas where destructive testing occurs at the Contractor's expense.

3.2 Installation

.1 Pre-installation Conference for epoxy injection, and sealant: one (1) week prior to installation of the above products into the Works, the Contractor shall conduct a meeting with applicator, installers of Work adjacent to or that penetrates the sealant products, and the Contract Administrator to review the following:

.1 General project requirements.

.2 Manufacture's product data sheets and installation guides.

.3 Substrate conditions and procedures for substrate preparation and product installations.

.4 Responsibility and costs associated with verification and correlation of field dimensions, fabrication processes, techniques of construction, installation, and coordination for all parts of the Work rests with the Contractor. Provide agenda and meeting minutes. Distribute agenda to the attendees four (4) days prior to the Pre-Installation Conference. Distribute Pre-Installation Conference meeting minutes within four (4) days of the meeting.

.5 Pay for all costs associated with the pre-installation conference excluding the Contract Administrator cost.

.2 Install all concrete accessories in accordance with Drawings and Manufacturer's recommendations and ensure compatibility. Install straight, level, and plumb.

.3 Ensure items are not disturbed during concrete placement.

.4 Coordinate Work of this Section with other construction.

3.3 PVC Waterstop

.1 Install PVC waterstop in all joints in a continuous and inter-connected manner.

.2 All waterstop joints other than straight butt joints shall be factory fabricated and tested by the waterstop supplier. All field splices shall be heat-fused and tested for complete seals by use of a corona discharge unit; costs for testing to be paid for by Contractor.

.3 Install waterstop continuous without displacing reinforcement. Butt weld splices to Manufacturer's directions. Secure in place to prevent dislodgment during placing of concrete.

.4 Take particular care to correctly position the waterstop during installation. Tie the waterstop adequately for support in accordance with Manufacturer's instructions, but at spacings no greater than 300 mm to ensure proper embedment, symmetry about the joint, and to prevent displacement during concrete placement. Fully compact the concrete in the region of the waterstop during the placing of the concrete.

.5 Do not place concrete until PVC waterstop has been reviewed by the Contract Administrator.

3.4 Expansive Waterstop

.1 Apply expansive waterstop where and if specifically indicated on the Drawings or as directed by the Contract Administrator.

.2 Prepare surfaces and apply beads sized to Manufacturer's instructions.

.3 Protect expansive waterstop from contact with water prior to concrete placement. Replace waterstop if it has come in contact with water and has begun to absorb water.

.4 Do not place concrete until expansive waterstop has been reviewed by the Contract Administrator.

3.5 Repair Mortar

.1 Apply repair mortar for defective concrete where directed by the Contract Administrator.

.2 Prepare surfaces and apply repair mortar to Manufacturer's instructions. Use pea gravel to extend the mixture in accordance with the Manufacturer's instructions.

3.6 Epoxy Injection

.1 Allow Contract Administrator to review dry temperature and shrinkage cracks prior to injection.

.2 Clean the cracks using the Manufacturer's approved cleaning agent and procedures prior to injection of resin.

.3 Injection to be completed in accordance with the Manufacturer's written instructions.

.4 Remove any cured injection resin from the surface of the structure.

.5 Allow minimum twenty-four (24) hours for the injection resin to cure prior to removal and patching of the packer holes.

END OF SECTION

CONCRETE REINFORCING

1. GENERAL

1.1 Work Included

.1 Reinforcing steel bars for cast-in-place concrete, complete with tie wire.

.2 Support chairs, bolsters, bar supports, spacers, and tie wire for reinforcing.

1.2 Quality Assurance

.1 Perform concrete reinforcing work in accordance with CSA A23.1.

1.3 Inspection and Testing

.1 Submit three (3) certified copies of the mill test report of reinforcement supplied, indicating physical and chemical analysis.

1.4 Shop Drawings

.1 Submit bar lists and placing drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Clearly indicate bar sizes, spacing, locations and quantities of reinforcing steel and wire fabric, bending and cutting schedules and supporting and spacing devices.

.3 Drawings and details to conform to latest edition of CSA A23.1, CSA-A23.3, and RSIC's Reinforcing Steel Manual of Standard Practice.

.4 Detail placement of reinforcing where special conditions occur.

.5 Detail splice lengths, bar development and hook development as shown on the Structural General Notes Drawing except as noted on other Drawings that indicated longer; splice length, bar development and hook developments. Use Class B top tension lap splices unless noted otherwise.

.1 All other details are to be maintained in accordance with CSA A23.1 and RSIC's Reinforcing Steel Manual of Standard Practice.

1.5 Delivery and Storage

.1 Deliver, handle, and store reinforcement in a manner to prevent damage and contamination.

.2 Deliver bars in bundles, clearly identified in relation to bar lists.

.3 Tarp/store bars to keep out of rain and snow. Store bars off of the ground.

2. PRODUCTS

2.1 Reinforcing Materials

.1 Reinforcing steel: 400 MPa yield grade; deformed billet steel bars conforming to CSA G30.18; plain finish.

2.2 Accessory Materials

.1 Tie wire: minimum 1.6 mm annealed type or patented system accepted by the Contract Administrator.

.2 Chairs, bolsters, bar supports, and spacers: adequately sized for strength and support of reinforcing steel during construction in accordance with the RSIC's Reinforcing Steel Manual of Standard Practice.

.3 Bar chairs to be non-corrosive PVC chairs or purpose made concrete chairs.

.4 Side form spacers to be non-corrosive PVC spacers, purpose made.

.5 Steel bar chairs, galvanized bar chairs, PVC chairs, concrete bricks, broken concrete blocks, or wood supports are not acceptable.

3. EXECUTION

3.1 Examination

.1 Before starting this Work, examine work done by other Division within Contract.

.2 Notify the Contract Administrator of any conditions that would prejudice proper completion of this Work.

.3 Commencement of Work implies acceptance of existing conditions.

3.2 Fabrication

.1 Fabricate reinforcing steel in accordance with CSA A23.1 and the Drawings.

.2 Locate reinforcing splices not indicated on the Drawings at points of minimum stress.

.3 Fabricate within the following tolerances:

.1 Sheared length: plus 0, minus 25 mm.

.2 Stirrups, ties, and spirals: plus 0, minus 10 mm.

.3 Depth of truss bars: plus 0, minus 10 mm.

.4 All bending shall be done cold with a suitable machine accurately producing all lengths, depths, and radii shown on the bending details.

.5 After initial fabrication, reinforcing steel shall not be re-bent or straightened unless so indicated on the Drawings.

.6 Heating of reinforcing steel will not be permitted.

3.3 Installation

.1 Place reinforcing steel in accordance with reviewed placing drawings and CSA A23.1.

.2 Chairs supporting slab reinforcing shall not be further apart than 1200 mm in either direction. Tie reinforcing steel at maximum spacing 600 mm.

.3 Adequately support reinforcing and secure against displacement within tolerances permitted.

.4 Place reinforcing steel to provide concrete cover as required by CSA A23.1, but not less than shown in the following table, unless shown otherwise on the Drawings:

Location	**Coverage (mm)**
Top and sides of beams	50
Top, sides and bottom of floor slabs	50
Surface poured against ground, piles, bottom of slabs on grade	75
Pile caps (all faces and to outside of ties/stirrups)	60
Housekeeping pads	50

.5 Place reinforcing bars to tolerances in accordance with CSA A23.1, Clause 6.6 – Fabrication and Placement of Reinforcement. Tolerances are not cumulative.

3.4 Safety Protection for Reinforcing Ends

.1 Highly visible protection safety caps or other acceptable safety product shall be installed for all reinforcing ends immediately following placement of bars.

.2 The reinforcing end protection shall be made secure so that accidental contact will not easily dislodge the protection. Dislodged protection shall be re-installed immediately.

3.5 Cleaning

.1 Ensure concrete reinforcing is clean and free from oil and deleterious matter.

.2 Remove all loose scale, loose rust, concrete from prior pours, and other deleterious matter from surfaces of reinforcing.

END OF SECTION

CAST-IN-PLACE CONCRETE

1. GENERAL

1.1 Work Included

.1 Supply of all reinforced cast-in-place concrete shown on the Drawings.

.2 Setting anchors, inserts, frames, sleeves, and other items supplied by other Sections.

.3 Placing and curing of concrete.

.4 Finishing formed concrete surfaces.

.5 Finishing concrete slab surfaces.

.6 Repairing concrete imperfections.

.7 Third-party Testing.

1.2 References

.1 National Building Code of Canada 2010 and Manitoba Amendments (2011 edition).

.2 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.3 CSA-A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

.4 ASTM C 260/C260M, Standard Specification for Air-Entraining Admixtures for Concrete.

.5 ASTM C494/C494M, Standard Specification for Chemical Admixtures for Concrete.

.6 All standards to be latest edition unless noted otherwise.

1.3 Quality Control

.1 The Contractor shall be fully responsible for quality control of all aspects of production, pre-placement, placement, and post-placement of concrete and related testing.

.2 Cast-in-place concrete shall conform to the CSA A23.1. Concrete shall be delivered under the Performance Alternative as outlined in CSA A23.1, Table 5.

.3 Testing of cast-in-place concrete shall be performed by a CSA A23.1 certified Third-party Testing Agency paid for by the Contractor. Testing shall conform to CSA A23.1/A23.2, and as specified below.

.1 Take five(5) test cylinders from each 50 cubic metres of each class of concrete placed or for each day of concrete placement if the latter is less than 50 cubic metres. Testing shall be as follows:

.1 One (1) – Seven (7) day laboratory cured test.

.2 Two (2) – Twenty-eight (28) day laboratory cured tests.

.3 Two (2) - Fifty-six (56) day laboratory cured tests.

.2 Take one (1) additional test cylinder during cold weather concreting or if Sulphate resistance cement has been used. Cure cylinder on job site under same conditions as concrete that it represents.

.3 Make at least one (1) slump test for each set of test cylinders taken.

.4 Cure concrete test cylinders in location designated by testing agency for a minimum of forty-eight (48) hours prior to transporting to laboratory.

.5 Additional testing required due to low, inaccurate or otherwise questionable results shall be paid by the Contractor.

.6 Distribute the Third-party Testing Agency test data to the Contract Administrator and City immediately upon receiving.

.7 Submit and implement a Quality Control Plan a minimum of four (4) weeks prior to first scheduled concrete casting; the Quality Control Plan shall include:

.1 Identify the Quality Control Manager.

.2 Qualifications of construction supervisory personnel.

.3 Quality Control testing plan for concrete.

.4 Third-party testing data from trial batching of each mix type.

.5 Pre-placement procedures, checklists, and project specific finishing procedures for concrete.

.6 During placement contingency plans and procedures.

.7 Post-placement procedures and checklists for concrete.

.8 Submit mix design statements for each type of concrete:

.1 Mix design statements shall be sealed and signed by a Professional Engineer registered in the Province of Manitoba experienced in preparing concrete mix designs.

.2 Submit documentation a minimum of four (4) weeks prior to the first scheduled concrete casting demonstrating that the proposed mix designs and materials will achieve the required strength, durability, and performance requirements.

.3 The mix design statements shall clearly correlate to the mix types in Table 1 at the end of this Section.

.9 Submit the Quality Control Plan and mix design statements in accordance with Section 01 33 00 – Submittal Procedures.

1.4 Quality Assurance

.1 Checklists supplied by the Contractor and approved for use by the Contract Administrator will be used for reviewing the Work.

.2 Notify the Contract Administrator at least forty-eight (48) hours before complete formwork, embedded items, and concrete reinforcement is ready for review. Contractor shall schedule review of embedded items and reinforcing in walls prior to closing forms.

.3 Allow ample time for review, and corrective work, if required, before scheduling concrete placement.

.4 The City reserves the right to arrange and pay for a CSA A23.1 certified Third-party Testing Agency to test the concrete works. Provide unencumbered access to all portions of the Work and cooperate with appointed Third-party Testing Agency.

2. PRODUCTS

2.1 General

.1 All materials in concrete mixes shall be compatible.

2.2 Concrete Materials

.1 Portland Cement: Type GU/GUb and Type HS or HSB to CSA A3000.

.2 Fine aggregate: conforming to Normal-Density Fine Aggregate, CSA A23.1, Tables 10 and 12. Provide evidence at least four (4) weeks before use in concrete mix showing conformance to Normal-Density Fine Aggregate, CSA A 23.1.

.3 Coarse aggregate: conforming to Normal-Density Coarse Aggregate, CSA A23.1, Table 11 and 12. Provide evidence at least four (4) weeks before use in concrete mix showing conformance to Normal-Density Coarse Aggregate, CSA A 23.1.

.4 Ensure that no aggregates are used that may undergo volume change due to alkali reactivity, moisture retention or other causes. Confirm suitability of aggregate with a petrographic analysis.

.5 Water: potable, clean, and free from injurious amounts of oil, alkali, organic matter, or other deleterious matter, meeting requirements of CSA A23.1, Table 9.

.6 Materials are to be obtained from the same source of supply or Manufacturer for the duration of the Project.

.7 Supplementary cementing materials: conforming to CSA A3000.

2.3 Admixtures

.1 Air entrainment: conforming to ASTM C 260/C260M.

.2 Chemical admixtures, water-reducing agent, superplasticizer: conforming to ASTM C 494.

.3 Admixtures containing chlorides will not be permitted.

2.4 Accessories

.1 For accessories refer to Section 03 15 00 – Concrete Accessories.

2.5 Concrete Mixes

.1 Provide concrete mixed in accordance with requirements of CSA A23.1 and this Specification Section. Pay all costs for the mix design.

.2 Concrete design compressive strength and class of exposure as indicated in attached Table 1. Concrete mixes are to be designed to mitigate dry and plastic temperature and shrinkage cracks.

.3 Conduct trial batching for each mix type in Table 1. Conduct testing of each trail batch to ensure the mix deign meets the requirements this Specification and CSA A23.1. Submit testing of each trial batch to the Contract Administrator in accordance with Section 01 33 00 – Submittal Procedures prior to construction of the Work.

.4 Use accelerating admixtures in cold weather only when accepted by the Contract Administrator. If accepted, the use of admixtures will not relax cold weather placement requirements. Do not use calcium chloride.

.5 Use set-retarding admixtures during hot weather only when accepted by the Contract Administrator.

.6 All admixtures are subject to acceptance by the Contract Administrator. List all proposed admixtures in mix design statement submission. Do not change or add admixtures to accepted design mixes without the Contract Administrator's review and acceptance.

.7 Concrete delivered to site must be accompanied by a delivery slip in accordance with CSA A23.1.

.8 Self-consolidating concrete mixes will not be permitted for use on this project.

3. EXECUTION

3.1 Pre-Installation Conference

.1 Pre-installation conference for cast-in-place concrete: four (4) weeks prior to installation of concrete works, the Contractor shall conduct a meeting with mix designer, batch plant quality control manager, third-party testing agency representative, concrete installers, concrete finishers, concrete curing applicators, concrete sealer technical representative, reinforcing steel installers, floor coating applicators, installers of work adjacent to or that penetrates the concrete works, and the Contract Administrator to review the following:

.1 General project requirements;

.2 Concrete sequence plan showing construction joints;

.3 Contractor's quality control plan for each class of concrete; and

.4 Contractor's procedures prior, during, and following concrete castings.

.2 Provide agenda and meeting minutes. Distribute agenda to the attendees four (4) days prior to the pre-installation conference. Distribute pre-installation conference meeting minutes within four (4) days of the meeting.

.3 Pay for all costs associated with the pre-installation conference excluding the Contract Administrator's cost.

3.2 Placing Concrete

.1 Place concrete in accordance with requirements of CSA A23.1 and as indicated on the Drawings. Layout of the Work and accuracy of same is the Contractor's sole responsibility.

.2 Place concrete to mitigate dry and plastic temperature and shrinkage cracks.

.3 Prior to the erection of the formwork, construction joints shall be sand blasted and cleaned as per clause 3.8 - Construction Joints of this specification section.

.4 Notify the Contract Administrator a minimum of forty-eight (48) hours prior to placing concrete. Under no circumstances shall concrete be placed without notifying Contract Administrator.

.5 Arrange for testing of cast-in-place concrete.

.6 The concrete shall be placed rapidly and evenly as near to its final position as possible to reduce the risk of segregation, flowlines, and cold joints.

.7 Ensure all anchor bolts, seats, plates, and other items to be cast into concrete are securely placed and will not interfere with concrete placement and will not be displaced during casting.

.8 All equipment for transporting the concrete shall be cleaned of hardened concrete and foreign materials before placing concrete.

.9 Immediately before concrete is placed, Contractor shall carefully inspect all forms in accordance with Section 03 10 00 – Concrete Forming and Accessories, to ensure that they are properly placed, sufficiently rigid and tight, and that all reinforcing steel and embedded parts are in the correct position and secured against movement during the placing operation. All forms shall be thoroughly cleaned and material removed.

.10 Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable by methods that will prevent the separation or loss of the ingredients. Concrete shall be deposited in the forms as nearly as practicable in its final position to avoid re-handling or flowing. Vibrators shall not be used to move concrete. Under no circumstances shall concrete that has partially hardened be deposited in the forms.

.11 Concrete shall be thoroughly compacted by mechanical vibrators during placing operations. Concrete shall be thoroughly worked around the reinforcement, embedded fixtures and into the corners of the forms.

.12 Vibrate concrete using the appropriate size equipment as placing proceeds, in accordance with CSA A23.1. Check frequency and amplitude of vibrations prior to use. Provide additional standby vibrators in the event of equipment failure.

.13 Where placing operations would involve dropping the concrete more than 1500 mm, it shall be placed through canvas hoses or galvanized iron chutes. Concrete shall not be raised at a rate greater than that for which proper vibration may be affected.

.14 In locations where new concrete is dowelled to existing concrete, drill holes in existing concrete, clean thoroughly, pack solidly with epoxy grout suitable for intended exposure, and insert steel dowels.

.15 At construction or expansion joints a minimum of three (3) days shall elapse between adjacent castings and the adjacent casting shall have obtained 75% of the design strength.

.16 Main floor slab is to obtain 75% of the strength prior to backfilling of the structure.

.17 Do not place concrete if carbon dioxide producing equipment has been in operation in the building or in the enclosure during the twelve (12) hours preceding the pour. This equipment shall not be used during placing or for twenty-four (24) hours after placing. During placing and curing concrete, surfaces shall be protected by formwork or an impermeable membrane from direct exposure to carbon dioxide, combustion gases or drying from heaters.

.18 Honeycomb and embedded debris are not acceptable.

.19 Remove and replace defective concrete.

.20 Maintain accurate records of cast-in-place concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

.21 Prepare set or existing concrete by removing all laitance and loose or unsound materials and apply bonding agent in accordance with manufacturer's recommendations.

3.3 Hot and Cold Weather Concreting

.1 Deliver, place and cure concrete in hot or cold weather in accordance with the requirements in CSA A23.1.

3.4 Concrete Protection for Reinforcement

.1 Ensure reinforcement is placed to provide minimum concrete cover in accordance with Section 03 20 00 – Concrete Reinforcement.

3.5 Construction Tolerance

.1 The Work shall be carefully and accurately set out; true to the positioning, levels, slopes, and dimensions shown on the Drawings and conforming to tolerance requirements of CSA A23.1 and Section 03 10 00 – Concrete Forming and Accessories and Section 03 20 00 – Concrete Reinforcing.

.2 If these tolerances are exceeded, the Contractor shall, at the discretion of the Contract Administrator, be required to remove and replace, or to modify the placed concrete before acceptance at own cost.

3.6 Finishing Slab Surfaces

.1 Screeding, bull floating or darbying, floating, and trowelling of slab surfaces shall conform to CSA A23.1.

.1 Finish interior main floor slab surfaces to CSA A23.1, Table 21, Class A utilizing magnesium bull float followed by magnesium hand float for air entrained concrete and steel blade power trowel for non-air entrained concrete.

.2 Finish exterior equipment slab surfaces to CSA A23.1, Table 21, Class A utilizing magnesium bull float followed by magnesium hand float for air entrained concrete and steel blade power trowel for non-air entrained concrete.

.2 Broom finish exterior slab surfaces to achieve nonslip surface conforming to CSA A23.1.

3.7 Finishing Formed Concrete

.1 Allow the Contract Administrator to review concrete surfaces immediately upon removal of the forms.

.2 Modify or replace concrete not conforming to qualities, lines, details, and elevations specified herein or indicated on the Drawings to the satisfaction of the Contract Administrator.

.3 Finish for the exterior surfaces of the substructure shall be rough-form finish conforming to CSA A23.1, Clause 7.7.

3.8 Construction Joints

.1 Construction joint locations shall be as shown on the Drawings.

.2 Joints not indicated on the Drawings shall be located so as to least impair the strength of the structure. The location of these joints shall be subject to prior review and acceptance by the Contract Administrator. Submit location and detail of joints to Contract Administrator a minimum of four (4) weeks prior to scheduled concrete casting. Joints shall be in accordance with CSA A23.1, or as indicated on the Drawings.

.3 The surface of hardened concrete shall be thoroughly cleaned of foreign matter and laitance by sand blasting, and shall be thoroughly wetted with water, but not saturated, and the forms shall be re-tightened against the face of the hardened concrete before depositing additional concrete. Any concrete splatter on reinforcing bars shall be removed by sand blasting or other mechanical means.

.4 For horizontal construction joints, the concrete shall be thoroughly compacted by hand trowel in and around the reinforcing bars.

3.9 Curing and Protection

.1 Cure and protect freshly placed concrete in accordance with CSA A23.1.

.2 Floor slabs shall receive extended wet curing for a period of at least seven (7) calendar days.

.1 Surface covered with canvas or other satisfactory material and kept thoroughly and continuously wet with soaker hoses.

.3 All other concrete shall receive moist curing for a period of at least seven (7) calendar days. One of the following methods shall be used as soon as the concrete has hardened sufficiently to prevent marring:

.1 Surface covered with canvas or other satisfactory material and kept thoroughly and continuously wet with soaker hoses.

.2 A liquid membrane forming curing sealer, applied at the rate recommended by the manufacturer. Curing sealer shall not be used on a surface where bond is required for the finishes.

.3 Surfaces of concrete that are protected by formwork that is left in place for seven (7) calendar days, shall not require any additional curing (except as specified for hot weather). If the formwork is removed in less than seven (7) calendar days, the concrete shall receive moist curing as above.

.4 No concreting will be allowed until all materials required for the curing phase are on-site and ready for use.

.5 At the end of the curing and protection period, the temperature of the concrete shall be reduced gradually at a rate meeting both the requirements of CSA A23.1 Table 21 for allowable differential temperature in the concrete and ACI 306R Table 5.1 for the allowable rate of temperature change of the edges of the concrete until the outside air temperature has been reached.

.6 Concrete that is allowed to freeze, the Contract Administrator suspects has frozen, or obtained insufficient curing conditions shall be subject to all necessary investigations and testing as deemed necessary by the Contract Administrator and all such concrete shall be removed and the portion reconstructed as directed by the Contract Administrator, at the Contractor's cost.

.7 Use water available on Site for curing concrete.

3.10 Equipment Pads, Pipe Supports, and Cast in Metal Items

.1 Provide concrete pads and supports for equipment where and as indicated on Drawings. Adjust dimensions to reviewed equipment Shop Drawings.

.2 Insert bolts and sleeves and pack solidly with non-shrink grout, in accordance with setting details and templates.

.3 Steel trowel surface smooth. Chamfer exposed horizontal and vertical edges.

.4 Clean excess concrete from metal frames, inserts, weld plates, etc. Clean and tool concrete around the above noted items.

3.11 Grouting

.1 Grout all miscellaneous anchor bolts with non-ferrous or epoxy grout as specified or as required per reviewed equipment Shop Drawings using templates for accurate positioning.

.2 Prepare adjoining surfaces in accordance with the grout manufacturer's written instructions.

.3 Install and cure the grout in accordance with the grout manufacturer's written instructions.

3.12 Defective Concrete

.1 Concrete not meeting the requirements of the Specifications and Drawings will be considered defective concrete.

.2 Concrete not conforming to the lines, details, and grades specified herein or as shown on the Drawings shall be modified or replaced at the Contractor's expense and to the satisfaction of the Contract Administrator. Finished lines, dimensions, and surfaces shall be correct and true within tolerances specified herein and in Section 03 10 00 – Concrete Forming and Accessories.

.3 Concrete not properly placed resulting in honeycombing and other defects shall be repaired or replaced at the Contractor's expense and to the satisfaction of the Contract Administrator.

3.13 Repair

.1 Allow Contract Administrator to review concrete surfaces immediately upon removal of all formworks.

.2 Remove all exposed metal form ties, nails, and wires, break off fins and remove all loose concrete.

.3 Any imperfect joints, voids, stone pockets, or other defective areas and tie holes, as specified, shall at once be patched before the concrete is thoroughly dry. Defective areas shall be chipped away to a depth of not less than 40 mm with sawcut edges perpendicular or dovetail to the surface. The area to be repaired and a space at least 150 mm wide entirely surrounding it shall be wetted to prevent absorption of water from the repair mortar.

.4 Cure all repairs thoroughly in accordance with Manufacturer's instructions.

Table 1: Concrete Mix Types

Mix Type	Intended Application	Minimum Compressive Strength (MPa)	Class of Exposure
1	Exterior Below Ground Works: • Piles, pile caps, walls, grade beams.	35 at 56 Days	S-1
2	Non-Structural Concrete for Exterior Works: • Exterior slab on grade, bollard infill.	32 at 28 Days	C-2
3	Structural Concrete for Exterior Works.	35 at 56 Days	C-1
4	Structural or Non-Structural Interior Works: • Slab, columns, beams, curb, housekeeping pad.	35 at 28 Days	N
5	Concrete grout for masonry infill.	20 at 28 Days	N
6	Concrete topping.	25 at 28 Days	N
7	Hollow core grout.	35 at 28 Days	N

END OF SECTION

HOLLOW CORE PRECAST/PRESTRESSED CONCRETE

1. GENERAL

1.1 Description

.1 Refer to the drawings and specifications.

1.2 Related Work

.1 Cast-in-Place Concrete: Section 03 30 00.

.2 The following items relating to precast/prestressed slabs shall be part of the projects:

.1 Drypacking of gap between precast/prestressed slabs at all locations where load bearing walls are parallel to length of slab.

.2 Perimeter caulking.

.3 Electrical holes.

.4 Concrete topping (minimum 50 mm).

.5 Infill perimeter cores for adequate parapet anchorage.

.6 Infill cores at monorail support locations.

1.3 Reference Standards

.1 Do precast/prestressed concrete work in accordance with CSA A23.4 and CSA A23.3 (latest editions).

.2 Do welding in accordance with CSA W59 for welding to steel structures and CSA W186 for welding reinforcement.

1.4 Qualifications of Manufacturer

.1 Fabricate precast/prestressed concrete elements certified by the Canadian Standards Association in the appropriate category(ies) according to CSA Standard A23.4 "Precast Concrete - Materials and Construction". The precast concrete manufacturer shall be certified in accordance with the CSA Certification program for Structural Precast/Prestressed Concrete prior to submitting a tender and must specifically verify as part of his tender that he is currently certified in the appropriate category(ies):

.1 Precast Concrete Products – Structural:

.1 Prestressed:

.1 Only precast concrete elements fabricated by certified manufacturers are acceptable to the City.

.2 Certification must be maintained for the duration of the fabrication and erection for the project. Fabricate precast concrete elements in accordance with

National Building Code of Canada 2010 and Manitoba amendment code requirements.

.2 The precast concrete manufacturer shall be a member in good standing with the Canadian Precast/Prestressed Concrete Institute (CPCI) and have a proven record and satisfactory experience in the design, manufacture and erection of precast concrete facing units of the type specified. The company shall have adequate financing, equipment, plant and skilled personnel to detail, fabricate and erect the work of this Section as required by the Specification and Drawings. The size of the plant shall be adequate to maintain the required delivery schedule.

1.5 Design Criteria

.1 Design precast/prestressed concrete units to CSA A23.3 and to carry handling stresses.

.2 Design loads in accordance with applicable codes for use and occupancy, wind, temperature, and earthquake.

.3 Consider vibration characteristics in accordance with NBC.

.4 Design prestressed units to meet fire resistance rating as required for the project.

1.6 Source Quality Control

.1 Provide Contract Administrator with certified copies of quality control tests and inspection related to project as specified in CSA A23.4 and CSA G279.

.2 Inspection of prestressed concrete tendons is required in accordance with CSA G279.

.3 Provide Contract Administrator with certified copy of mill test report of reinforcing steel supplied, showing physical and chemical analysis.

1.7 Shop Drawings

.1 Submit Shop Drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Submit Shop Drawings in accordance with CSA A23.4 and CSA A23.3. The following items shall be provided:

.1 Design calculations for items designed by the Manufacturer.

.2 Estimated camber.

.3 Finishing schedules.

.4 Methods of handling and erection.

.5 Openings, inserts and related reinforcement.

.6 Each drawing submitted to bear stamp of qualified Professional Engineer registered in the Province of Manitoba.

1.8 Warranty

.1 This Contractor hereby warrants that the precast/prestressed elements will not spall or show visible evidence of cracking, except for normal hairline shrinkage cracks, in accordance with the General Conditions warranty clause, for a one-year period after Substantial Completion.

2. PRODUCTS

2.1 Materials

.1 Cement, aggregates, water, admixtures: To CSA A23.4 and CSA A23.1.

.2 Prestressing steel: Uncoated 7 wire cable conforming to CSA G279.

.3 Reinforcing steel: To CSA G30.18.

.4 Anchorages and couplings: To CSA A23.1.

.5 Embedded steel: To CSA G40.21, Type M300W.

.6 Welding materials: To CSA W48.1.

.7 Bearing pads: 3 mm masonite smooth one side.

.8 Insulation: Expanded polystyrene to CAN/CGSB-51-20.

.9 Air entrainment admixtures: To CSA A266.1.

.10 Chemical admixtures: To CSA A266.2.

2.2 Concrete Mixes

.1 Use concrete mix designed to produce 41 Mpa (6000 psi) compressive strength at twenty-eight (28) days with a maximum water/cement ratio to CSA A23.1, Table 2 for Class N exposure.

.2 Air entrainment of concrete mix: To CSA A266.4.

.3 Admixtures: To CSA A266.4, CSA A266.5.

.4 Do not use calcium chloride or products containing calcium chloride.

2.3 Joint Grout Mix

.1 Cement grout: One-part type 10 Portland cement 2 ½ parts sand, sufficient water for placement and hydration.

2.4 Infill Concrete

.1 Use infill concrete grout as per Section 03 30 00.

2.5 Manufacture

.1 Manufacture units in accordance with CSA A23.4.

.2 Mark each precast unit to correspond to the identification mark on shop drawings for location on a part of unit which will not be exposed.

.3 Provide hardware suitable for handling elements.

.4 Provide 50 mm (2") thick insulation plug at each cell end of hollow core.

3. EXECUTION

3.1 Erection

.1 Erect elements within the allowable tolerances indicated or specified.

.2 Erection tolerances to be non-cumulative in accordance with CSA A23.4.

.3 Install 3 mm masonite bearing pads, smooth side up when bearing on concrete or masonry supports.

.4 Set units in a tight, level position on true level bearing surface provided by others. Minimum bearing 90 mm on masonry and 75 mm on structural steel.

.5 Fasten precast/prestressed units in place as indicated on reviewed Shop Drawings.

.6 Level differential elevation of horizontal joints with grout to slope not more than 1:12.

.7 Clean field welds with a wire brush and touch up with primer.

.8 Field cut holes and openings up to 150 mm (6") diameter for mechanical trades. Openings larger than 150 mm (6") to be located on shop drawings at time of approval to be formed in the plant or cut in field. Do not cut reinforcing without prior approval of the precast hollow core slab manufacturer design engineer and the Contract Administrator.

3.2 Topping

.1 This contractor shall provide a suitable top finish to accept direct application of finished flooring/roofing as per room finish schedule.

.2 Where concrete topping (minimum 50 mm) is to be applied by others, refer to the appropriate specifications. The top surface of the precast/prestressed slabs is to be raked (roughened) for bonding of the topping.

3.3 Exposed Ceilings

.1 Caulk exposed ceiling longitudinal joints, using standard caulking.

.2 The underside of precast shall be finished as per CSA A23.4 (clause 24.2.2) STANDARD FINISH.

3.4 Clean-Up

.1 Upon completion of the Work of this Section, all surplus material and debris shall be removed from the Site.

END OF SECTION

CONCRETE TOPPING

1. GENERAL

1.1 Work Included

.1 Surface preparation of existing concrete.

.2 Third Party Testing.

.3 Finish bonded topping to indicate slopes.

.4 Wet Curing.

1.2 Quality Assurance

.1 Perform concrete Work to requirements of CSA A23.1.

.2 Finished concrete floor to conform to the slopes indicated on the Drawings.

.3 Retain a Third Party Testing Agency to test the tensile bond strength of the base slab and between the topping and base slab concrete.

1.3 Qualification

.1 Concrete shall be supplied in accordance with Section 03 30 00 - Cast-in-Place Concrete.

.2 Concrete finishing is to be done by an established firm having at least five (5) years of proven, satisfactory experience in this trade and employing skilled personnel.

1.4 Submission

.1 Submit proof of qualifications of concrete finishing experience in writing to the Contract Administrator.

.2 Submit a written plan for the entire process of installation of the bonded concrete topping including slab surface preparation, cleaning, forming, sequence of pours, placing and finishing methods, and remedial methods, at least three (3) weeks prior to placing of the topping concrete for review by the Contract Administrator.

2. PRODUCTS

2.1 Concrete

.1 Concrete shall be supplied in accordance with Section 03 30 00 - Cast-In-Place Concrete.

.2 The City reserves the right to arrange and pay for a CSA A23.1 certified Third Party Testing Agency to test the concrete works. Provide unencumbered access to all portions of the Work and cooperate with appointed Third Party Testing Agency.

2.2 Curing Compound

.1 Curing Compound is not permitted for use on bonded concrete topping.

2.3 Bonding Agent

.1 Bonding agent shall be a sand-cement slurry mixed in the proportions of 3:1 with only sufficient water to make a creamy mixture. Alternatively, commercial acrylic bonding agents such as Sika Canada Sikacem 810 or Specialty Construction Products Ltd. Acrl-Stix may be used.

3. EXECUTION

3.1 Examination

.1 Before starting this Work, examine Work done by other Divisions within Contract.

.2 Notify the Contract Administrator of any conditions that would prejudice proper completion of this Work.

.3 Commencement of Work implies acceptance of existing conditions.

3.2 Workmanship

.1 Obtain the Contract Administrator authorization before placing concrete.

.2 Place concrete in accordance with CSA A23.1 and Section 03 30 00 - Cast-In-Place Concrete.

.3 Construction of the floor topping shall proceed only in conditions that provide secure protection from rain and weather. Minimum ambient temperature during placement shall be 10°C; maximum ambient temperature shall be 35°C.

3.3 Preparation

.1 All preparatory work to be completed with utmost cleanliness. All equipment, vehicle tires, footwear, etc. to be cleaned or covered appropriately or they will be removed from the Site.

.2 Shot-blast base slab surface with a heavy shot blast to remove all contaminants, laitance, and other surface properties that will interfere with the bonding of the topping. The top surface of coarse aggregate must be uniformly exposed to an ICRI (International Concrete Repair Institute) CSP-5 profile. Provide a test sample surface for the Contract Administrator for review; this sample texture, once accepted, shall be the standard reference for acceptance for the remainder of the surface preparation on the project. The Construction Contractor will be required to re-shot-blast areas where contamination remains after the initial blast at no additional costs to the City.

.3 Development of bond between the topping and the substrate is primarily dependent upon excellent preparation of the surface. All dust, grit, and debris from shot-blast and sand-blast operations shall be meticulously removed and the surface washed.

.4 The base slab shall be saturated to an SSD (saturated surface dry) condition for a minimum of twenty-four (24) hours prior to placement of the concrete topping.

3.4 Installation Methods

.1 Immediately prior to the placement of the topping concrete, the surface shall be saturated, but free of all standing water, and the bonding agent slurry shall be broomed and worked into the substrate. The placement of the slurry shall proceed no further than 2 m in front of the placement of the topping concrete. At no time shall the slurry be permitted to dry.

.2 The topping concrete shall be vibrated, followed immediately by finishing procedures utilizing magnesium trowels.

.3 Normal trowelling operations shall proceed to achieve a dense, hard, smooth surface, free of trowel marks.

3.5 Curing

.1 Immediately upon completion of the final trowelling, wet-curing shall commence.

.2 The surface shall be entirely covered with a curing blanket consisting of pre-wetted burlap and then covered with polyethylene sheeting to retain the moisture. The burlap must be kept continually wet over the entire surface including all corners for a minimum period of seven (7) days. The maintenance of an excellent curing environment is mandatory to assure that the required bond is developed during this time.

3.6 Tolerances

.1 Surface tolerances shall conform to the Sludge Collection Equipment Manufacturer's written requirements.

3.7 Field Quality Control

.1 Inspection and testing of concrete materials, concrete, and concrete placement will be carried out in accordance with Section 03 30 00 - Cast-In-Place Concrete and this Section.

.2 During placement of the topping concrete, full time monitoring of concrete slump shall be maintained. Adjustment of low slump by the addition of superplasticizers or of water shall be in accordance with CSA A23.1. Alternatively, small dosages of accepted retarders may be added at the batch plant to reduce slump loss during transit.

.3 Tensile testing of the bonded topping will be performed in accordance with CSA-A23.2. A minimum tensile bond strength of 0.9 MPa between topping and base slab concrete shall be achieved.

.1 Conduct a minimum of four (4) bond strength tests in the hollow core topping.

.2 Remediate the tested areas in accordance with Section 03 33 00 - Cast-in-Place Concrete utilizing Repair Mortar in accordance with Section 03 15 00 - Concrete Accessories.

.3 Defective areas shall be fully removed, and the entire room surface shall be redone to eliminate cold joints in the topping.

END OF SECTION

1. GENERAL

1.1 Work Included

.1 Masonry Work is described in other Sections of Division 4.

1.2 References

.1 CSA A179, Mortar and Grout for Unit Masonry.

.2 CSA A371, Masonry Construction for Buildings.

1.3 Samples

.1 Submit samples in accordance with Section 01 33 00 – Submittal Procedures.

.2 Submit samples:

.1 Two (2) of each type of masonry unit specified.

.2 Two (2) of each type of masonry veneer unit specified.

.3 One (1) of each type of masonry accessory specified.

.4 One (1) of each type of masonry reinforcement and tie proposed for use.

.5 As required for testing purposes.

1.4 Information Submission

.1 Shop Drawings:

.1 Provide drawings stamped and signed by Professional Engineer registered or licensed in Province of Manitoba, Canada.

.2 Provide Shop Drawings detailing temporary bracing required, designed to resist wind pressure and lateral forces during installation.

.3 Provide Shop Drawing showing the location of the control joints, details of the control joints as per CSA A371.

.2 Certificates: provide manufacturer's product certificates certifying materials comply with specified requirements.

.3 Test and Evaluation Reports:

.1 Provide certified test reports.

.2 Test reports to certify compliance of masonry units and mortar ingredients with specified performance characteristics and physical properties.

.4 Installer Instructions: provide manufacturer's installation instructions, including storage, handling, and cleaning.

1.5 Product Delivery, Storage and Handling

.1 Deliver materials to job Site in dry condition.

.2 Keep materials dry until use, except where wetting of bricks is specified.

.3 Store under waterproof cover on pallets or plank platforms held off ground by means of plank or timber skids.

1.6 Cold Weather Requirements

.1 Supplement Clause 6.7.2.3 of CSA A371 with the following requirements:

.1 Maintain temperature of mortar between 5°C and 50°C until batch is used.

.2 Hoard equipment and materials to maintain temperature between 5°C and 50°C.

1.7 Hot Weather Requirements

.1 Protect freshly laid masonry from drying too rapidly, by means of waterproof, non-staining coverings.

1.8 Protection

.1 Keep masonry dry using waterproof, non-staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until masonry Work is completed and protected by flashings or other permanent construction.

.2 Protect masonry and other Work from marking and other damage. Protect completed Work from mortar droppings. Use non-staining coverings.

.3 Provide temporary bracing of masonry Work during and after erection until permanent lateral support is in place.

2. PRODUCTS

2.1 Materials

.1 Masonry materials are specified in other Sections of Division 4.

3. EXECUTION

3.1 Workmanship

.1 Do masonry Work in accordance with CSA A371 except where specified otherwise.

.2 Build masonry plumb, level, and true to line, with vertical joints in alignment.

.3 Layout coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings, with minimum of cutting.

3.2 Tolerances

.1 Tolerances to CSA A371.

3.3 Exposed Masonry

.1 Remove chipped, cracked, and otherwise damaged units in exposed masonry and replace with undamaged units.

3.4 Jointing

.1 Allow joints to set just enough to remove excess water, and then tool with round joints to provide smooth, compressed, uniformly concave joints where concave joints are indicated.

.2 Strike flush all joints concealed in walls and joints in walls to receive insulation, or other applied material except paint or similar thin finish coating.

3.5 Cutting

.1 Cut out neatly for electrical switches, outlet boxes, and other recessed or built-in objects.

.2 Make cuts straight, clean, and free from uneven edges.

3.6 Building-in

.1 Build in items required to be built into masonry.

.2 Prevent displacement of built-in items during construction. Check plumb, location, and alignment frequently, as Work progresses.

.3 Brace door jambs to maintain plumb. Fill spaces between jambs and masonry with mortar.

3.7 Support of Loads

.1 Use concrete to Section 03 30 00 - Cast-in-Place Concrete, where concrete fill is used in lieu of solid units, such as vertical cores, bond beams, and lintels.

.2 Install building paper below voids to be filled with concrete or grout; keep paper 25 mm back from faces of units.

3.8 Provision for Movement

.1 Co-ordinate the roof deflection space required between a masonry wall and a roof component.

3.9 Control Joints

.1 Construct continuous control joints as per CSA A371. Construct continuous control joints to be a maximum 8 m o/c.

.2 Provide Shop Drawing showing the location of the control joints and details of the control joints.

3.10 Field Quality Control

.1 Inspection and testing will be carried out by a testing laboratory designated by the Contractor and as approved by the Contract Administrator.

.2 The Contractor will pay costs for testing as incidental to the Contract.

END OF SECTION

MASONRY MORTARING

1. GENERAL

1.1 Work Included

.1 Provide all materials and labour to perform the mortar and grout Work for all masonry walls indicated on the Drawings.

1.2 References

.1 CSA A179 Mortar and Grout for Unit Masonry.

1.3 Samples

.1 Submit samples in accordance with Section 01 33 00 – Submittal Procedures.

2. PRODUCTS

2.1 Materials

.1 Mortar and grout: conforming to CSA-A179.

.2 Aggregate: conforming to CSA-A179.

.3 Water: clean, potable, free of injurious amounts of acids, alkalis, and organic material.

.4 Masonry cement: conforming to CSA-A3002, Type S.

.5 Portland cement: conforming to CSA-A3001, normal Type GU.

.6 Hydrated lime: conforming to ASTM C207.

.7 Dirt resistant additives: aluminum tristearate, calcium stearate, or ammonium stearate.

2.2 Material Source

.1 Use same brands of materials and source of aggregate for entire Project.

2.3 Mortar Types

.1 Mortar for all masonry:

.1 Type S based on Property Specifications.

2.4 Grout

.1 Grout: to CSA-A179, Table 3.

3. EXECUTION

3.1 Mixing

.1 Do masonry mortar and grout Work in accordance with CSA A179 except where specified otherwise.

.2 Mix grout to semi-fluid consistency.

.3 Incorporate admixtures into mixes in accordance with Manufacturer's instructions.

.4 Comply with cold weather requirements specified in CSA A371 Masonry Construction for Buildings.

3.2 Testing

.1 The City reserves the right to arrange and pay for a certified Third Party Testing Agency to perform additional testing. Provide unencumbered access to all portions of the Work and cooperate with appointed Third Party Testing Agency.

END OF SECTION

1. GENERAL

1.1 Work Included

.1 Supply all material and labour for the incorporation of the masonry reinforcement and connectors into the Work of this Contract.

1.2 References

.1 CSA A23.1, Concrete Materials and Methods of Concrete Construction.

.2 CSA A370, Connectors for Masonry.

.3 CSA A371, Masonry Construction for Buildings.

.4 CSA G30.3, Cold-Drawn Steel Wire for Concrete Reinforcement.

.5 CSA G30.18, Billet-Steel Bars for Concrete Reinforcement.

.6 CSA S304.1, Masonry Design for Buildings (Limit States Design).

.7 CSA W186, Welding of Reinforcing Bars in Reinforced Concrete Construction.

1.3 Source Quality Control

.1 Submit certified copy of mill test report of reinforcement steel and connectors, showing physical and chemical analysis, minimum five (5) weeks prior to commencing reinforcement Work.

.2 Inform the Contract Administrator of proposed source of material to be supplied.

1.4 Shop Drawings

.1 Submit Shop Drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Shop Drawings shall consist of bar bending details, lists, and placing drawings.

.3 On placing Shop Drawings, indicate sizes, spacing, location, and quantities of reinforcement and connectors.

2. PRODUCTS

2.1 Materials

.1 Bar reinforcement: to CSA A371 and CSA-G30.18, Grade 400.

.2 Wire reinforcement: to CSA A371 and CSA-G30.3, Truss type.

.3 Corrosion protection: to CSA S304.1, galvanized.

.4 Masonry anchors: acceptable products by Hilti or approved equal in accordance with B7.

.5 Connectors: to CSA A370 and CSA S304.1.

.1 Slotted block tie complete with insulation clip to masonry support wall.

.2 Slotted extension strip for dimensional stone veneer.

.6 Corrosion protection: to CSA S304.1, galvanized to CSA-S304.1 and CSA A370.

.7 Ties: hot dip galvanized to CSA A370 Table 5.2 steel finish.

.1 Corrugated to CSA A370.

.2 Unit ties, to CSA A370: Z style, fabricated from galvanized cold-drawn steel, size to suit application.

.3 Adjustable Unit Ties: to CSA A370: proprietary type ties, type, style and size to suit application in accordance with Manufacturer's recommendations.

.1 Minimum spacing:

.1 Vertical: 600 mm.

.2 Horizontal: 800 mm.

.2 From opening edge/corner: 200 mm max.

.4 Joint Reinforcement Ties: to CSA A370:

.1 Single Wythe Joint Reinforcement: Truss type:

.1 Steel wire, hot dip galvanized: to ASTM A 641M, Class 1 after fabrication.

.2 Cold drawn steel wire conforming to ASTM A 82/82M.

.8 Control joint filler: preformed rubber, neoprene, or polyvinyl chloride materials of size and shape indicated.

.9 Movement Joint Filler: purpose-made, of size and shape indicated.

.1 Maximum VOC content - 250 g/L (less water) in accordance with SCAQMD Rule 1168.

.2 Material type: self-expanding, pre-compressed, open cell, 100% acrylic, impregnated expanding foam sealant, with self-adhesive on one face.

.10 Lap adhesive: recommended by masonry flashing manufacturer.

.1 Maximum VOC Content: 80 g/L (less water) in accordance with SCAQMD Rule 1168.

.11 Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, honeycomb design, full height and width of head joint and depth 3 mm less than depth of outer wythe, in colour selected from manufacturer's standard range.

.1 Blok-Lok Cellvent, Advanced Building Products Mortar Maze Cell Vents, or approved equal in accordance with B7.

.12 Mortar Dropping Control Device: Free-draining mesh; made from polymer strands that will not degrade within wall cavity.

.1 Strips, full-depth of cavity and 250 mm high, with dovetail shaped notches 175 mm deep that prevent clogging with mortar droppings.

.2 Acceptable products: Mortar Net “Mortar Net”, Hohmann & Barnard, Inc. “Mortar Trap”, or approved equal in accordance with B7.

.13 Grout Screens: 6 mm square monofilament screen is fabricated form high-strength, non-corrosive polypropylene polymers to isolate flow of grout in designated areas.

.1 Size: width to suit masonry units by 30 m.

.14 Flashings:

.1 Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual". Fabricate metal drip edge from galvanized sheet steel, 0.61 mm thick, in sections 2400 mm long minimum. Extend at least 75 mm into wall and 13 mm out from wall, with outer edge bent down 30 degrees and hemmed.

.2 Flexible Through Wall Flashing: self-adhering, as specified for air/vapour barrier specified in Section 07 21 20 - Rigid Insulation and Air Barrier.

2.2 Fabrication

.1 Fabricate reinforcing in accordance with CSA A23.1.

.2 Fabricate connectors in accordance with CSA A370.

.3 Obtain the Contract Administrator's acceptance for locations of reinforcement splices other than shown on placing drawings.

.4 Subject to review by the Contract Administrator, weld reinforcement in accordance with CSA W186.

.5 Ship reinforcement and connectors, clearly identified in accordance with the Drawings.

3. EXECUTION

3.1 General

.1 Install masonry connectors and reinforcement in accordance with CSA A370, CSA A371, CSA A23.1 and CSA S304.1 unless indicated otherwise.

.2 Comply with Manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

.3 Prior to placing concrete and mortar, obtain Contract Administrator's acceptance of placement of reinforcement and connectors.

.4 Do additional reinforcement of masonry as indicated.

3.2 Flashing, Weep Holes, Cavity Drainage, and Vents

.1 General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

.2 Vents: Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/vent products or open head joints to form vents.

.1 Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

.3 Mortar Dropping Control Devices: Install mortar dropping control devices in cavity air space continuously at base of wall, shelf angles, and lintels over openings.

.4 Grout Screens: Install purpose made diverters in cavities where indicated and as directed, size and shape to suit purpose and function.

.5 Build in flashings in masonry in accordance with CSA A371.

.1 Prepare concrete and masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.

.2 At lintels, extend flashing minimum 150 mm into masonry at each end. At heads and sills, extend flashing 150 mm at ends and turn up not less than 50 mm to form end dams.

.3 Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 13 mm back from outside face of wall and adhere flexible flashing to top of metal drip edge.

.4 In cavity walls and veneered walls, carry flexible flashings from front edge of exterior masonry, under outer wythe, then up backing not less than 200 mm. Bond to wall using manufacturer's recommended adhesive.

.5 Lap joints 150 mm and seal with adhesive.

.6 Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

.7 Install vertical flashing where outer veneer returns at window or door jambs, to prevent contact of veneer with inner wall.

3.3 Bonding and Tying

.1 Tie masonry veneer to backing in accordance with NBC, CSA S304.1, CSA A371, and as indicated.

3.4 Reinforced Lintels and Bond Beams

.1 Reinforce masonry lintels and bond beams as indicated.

.2 Place and grout reinforcement in accordance with CSA S304.1.

3.5 Grouting

.1 Grout masonry in accordance with CSA S304 and as indicated.

3.6 Masonry Anchors

.1 Install metal anchors where indicated.

.2 If masonry anchors are not specified on the Drawings, review proposed anchor and application with the Contract Administrator prior to use.

3.7 Lateral Support and Anchorage

.1 Do lateral support and anchorage in accordance with CSA S304.1 and as indicated.

3.8 Control Joints

.1 Terminate reinforcement 25 mm short of each side of control joints unless otherwise indicated.

3.9 Field Bending

.1 Do not field bend reinforcement and connectors 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 and connectors which develop cracks or splits.

3.10 Cleaning

.1 Upon completion of installation, remove surplus materials, rubbish, tools, and equipment barriers.

END OF SECTION

CONCRETE UNIT MASONRY

1. GENERAL

1.1 Work Included

.1 Concrete Block Masonry.

.2 Concrete Block Masonry Veneer.

.3 Installation of Masonry Accessories.

1.2 Standards

.1 CSA A165 Series, Standards on Concrete Masonry Units.

.2 Perform masonry Work to CSA S304.1, CSA A370, and CSA A371 except where specified otherwise.

.3 Conform to National Building Code of Canada 2010 and the Manitoba Amendments.

1.3 Shop Drawings

.1 Submit Shop Drawing for the temporary bracing of the masonry walls used in the Work.

.2 Submit Shop Drawings in accordance with Section 01 33 00 – Submittal Procedures.

.3 Clearly indicate sizes, connections, attachments, reinforcing, anchorage, size, and type of fasteners and accessories.

.4 Include erection drawings, elevations, and details where applicable.

.5 Shop Drawings and design briefs are to be signed and sealed by a Professional Engineer registered in the Province of Manitoba.

1.4 Cold Weather Requirements

.1 Conform to weather protection requirements in CSA A371.

.2 Masonry units shall be warmed to minimum 5°C prior to install.

1.5 Protection

.1 Cover tops of completed and partially completed walls with waterproof coverings at end of each working day. Drape covers over walls and extend 600 mm down both sides. Anchor securely in position.

.2 Protect adjacent finished surfaces from marking or damage due to masonry Work.

.3 Provide temporary bracing of masonry Work during erection to prevent damage due to winds or other lateral loads until permanent structure provides adequate bracing.

1.6 Storage and Handling

.1 Store materials on Site in a manner to prevent damage. Store masonry units off the ground.

.2 Protect all materials from damage due to weather conditions.

.3 Handle materials carefully to prevent chipping and breaking.

2. PRODUCTS

2.1 Materials

.1 Standard Concrete blocks: to CSA A165.1, normal weight and light weight as shown in the drawing, type H/15/A/M, units to be manufactured by Expocrete or approved equal in accordance with B7.

.1 Dimensions: modular size of 200/250W x 200H x 400L, refer to Drawings for locations of different sizes and weights.

.2 Special shapes: provide Type H/15/A/M bull-nosed units for exposed corners. Provide purpose made shapes for lintels (U-blocks) and bond beams (Knockout Blocks). Provide additional special shapes as indicated or required.

.2 Veneer Concrete Masonry Units: to CSA A165.1, normal weight, type H/15/A/M, units to be manufactured by Expocrete or approved equal in accordance with B7.

.1 Dimensions: Modular size of 100 W x 200 H x 400 L.

.2 Special Shapes: Provide L-Corner units for exposed corners. Provide additional special shapes as indicated.

.3 Profile:

.1 Full Split Face.

.2 Smooth Face.

.4 Colour:

.1 Integrally coloured pre-finished architectural concrete block with one or more faces ground to expose variegated colours of natural aggregates.

.2 Colour 591 “Manitoba Stone”. Full Split Face.

.3 Colour 606 “Brick Red”. Smooth Face.

.3 Exposed Faces:

.1 Notwithstanding visual inspection requirements of CSA Standards, masonry units shall be free of surface indentations, surface cracks due to manufacture or chipping. Units so delivered shall not be used.

2.2 Cleaning Compounds

.1 Use low VOC products.

.2 Compatible with substrate and acceptable to masonry manufacturer for use on products.

.3 Cleaning compounds compatible with concrete unit masonry and in accordance with Manufacturer's written recommendations and instructions.

2.3 Tolerances

.1 Tolerances for standard concrete unit masonry tolerances in accordance with CAN/CSA A165.1, supplemented as follows:

.1 Maximum variation between units within specific job lot not to exceed 2 mm.

.2 No parallel edge length, width or height dimension for individual unit to differ by more than 2 mm.

.3 Out of square tolerance not to exceed 2 mm.

3. EXECUTION

3.1 Workmanship

.1 Build masonry Work true-to-line, plumb, square, and level, with vertical joints in proper alignment.

.2 Tolerances for exposed masonry Work shall be:

.1 Variation from mean plane: 3 mm under 2500 mm straight edge.

.2 Variation in masonry openings: 6 mm maximum.

.3 Variation from plumb: 9 mm in 6 m.

.3 Assume complete responsibility for dimensions, plumbs, and levels of this Work and constantly check same with graduated rod.

.4 Masonry courses to be of uniform height, and both vertical and horizontal joints to be of equal and uniform thickness.

.5 Construct walls upward in a uniform manner, no one portion being raised more than 1200 mm above another at any time.

.6 Buttering corners of units, throwing mortar into joints, and deep or excessive furrowing of bed 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.

3.2 Blockwork

.1 Lay concrete block in running bond, with thicker end of face shell upward. Coursing to be modular 200 mm for one block and one joint.

.2 Use special shaped units where indicated, specified, or required. Use bull-nosed units for exposed external corners at door and window jambs. Exposed open cells not permitted.

.3 Concrete masonry units shall have face shells and their end joints fully filled with mortar, and joints squeezed tight. Also fill webs at cores, to be reinforced and grouted, and strike flush at core taking care to prevent mortar from falling into core.

.4 Tie intersecting non-bearing walls together with masonry reinforcing every second course.

.5 Do not tie intersecting bearing walls together in masonry bond, except at corners.

3.3 Mortar and Pointing

.1 Make all joints uniform in thickness, straight, in line, and with mortar compressed to form concave joints.

3.4 Building In

.1 Build in door and window frames, steel lintels, sleeves, anchor bolts, anchors, nailing strips, and other items to be built into masonry.

.2 Do not distort metal frames. Bed anchors of frames in mortar and fill frame voids with mortar or grout as walls are erected.

3.5 Bearings

.1 Fill concrete block solid with 20 MPa concrete for two cores and two (2) courses below bearing points of structural members unless indicated otherwise on the Drawings.

3.6 Masonry Reinforcing

.1 Concrete block walls and partitions shall be continuously reinforced and tied together with masonry reinforcing in every second block bed joint.

.2 Place masonry joint reinforcing in first and second bed joints above and below openings. Reinforcing in first bed joint shall be continuous. Second bed joint reinforcing shall extend 600 mm beyond each side of opening.

.3 Place continuous reinforcing in second bed joint below the tops of walls.

.4 Lap reinforcement minimum of 150 mm at splices and cut and bend corners.

.5 Vertical reinforcing bars to be continuous into lintels, through intermediate bond beams, and extend into the top most wall bond beam for the bond beams fully height minus 50 mm. Fill cores with 20 MPa concrete.

3.7 Cutting Masonry

.1 Cutting of masonry units exposed in finished Work is to be done with accepted type power saw. Where electrical conduit outlets and switch boxes occur, grind and cut units before services are installed.

.2 Obtain the Contract Administrator's permission before cutting any part of area which may impair appearance or strength of the Work.

.3 Patching of masonry is not permitted without the Contract Administrator’s authorization.

3.8 Bond Beams

.1 Install concrete block bond beams where indicated and where required for bearing of structural members.

.2 Make bond beams of knockout blocks with two (2) 15M reinforcing bars and fill with 20 MPa concrete.

.3 Provide 200 mm high bond beam at 2400 mm maximum vertical spacing.

3.9 Reinforced Block Lintels

.1 Install reinforced concrete block lintels over openings as indicated on the Drawings using 20 MPa concrete.

.2 Cast and cure lintels on plank. Set special channel lintel blocks using specified mortar. Place wood stops at either end of lintel to prevent movement.

.3 Place 25 mm of concrete in voids, place in deformed reinforcing bars and place concrete to level of block sides. Rod and tamp concrete well without disturbing reinforcing. Allow lintels to cure seven (7) days before removing shores.

.4 Minimum bearing shall be 400 mm each side of openings.

3.10 Provisions for Other Trades

.1 Provide openings in masonry walls where required or indicated.

.2 Accurately locate chases and openings and neatly finish to required sizes.

.3 Where masonry encloses conduit, ducts, and piping, bring to proper level indicated and as directed. Do not cover any pipe or conduit chases or enclosures until advised that Work has been reviewed and tested.

.4 Build masonry neatly around conduit, ducts, sleeves, and piping passing through.

3.11 Cleaning

.1 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of block and finally by brushing.

.2 Scrub surfaces to be cleaned using non-acid cleaning solution of type that will not harm constructed masonry. Check masonry unit Manufacturer for acceptable solution. Clean trial test area and obtain permission to proceed.

.3 Use large amounts of water and do cleaning in accordance with solution Manufacturer's instructions.

.4 Point or replace defective mortar to match existing as required or directed.

.5 Repeat cleaning operations as often as necessary until Work is satisfactory.

END OF SECTION

STRUCTRUAL STEEL FOR BUILDINGS

1. GENERAL

1.1 References

.1 ASTM International Inc.:

.1 ASTM A 36/A 36M, Standard Specification for Carbon Structural Steel.

.2 ASTM A 307, Standard Specification for Carbon Steel Bolts and Studs, 414 MPa Tensile Strength.

.3 ASTM A 325M, Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength Metric.

.4 ASTM A 490M, Standard Specification for High-Strength Steel Structural Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints Metric.

.5 ASTM F 1554, Standard Specification for Anchor Bolts, Steel 36, 55 and 105 ksi.

.2 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturers Association (CPMA), Latest edition:

.1 Handbook of the Canadian Institute of Steel Construction.

.2 CISC/CPMA Standard 2-75, Quick-Drying Primer for use on Structural Steel.

.3 CISC/CPMA Standard 1-73a – A Quick-Drying One-Coat Paint for Use on Structural Steel.

.3 Canadian Standards Association (CSA International), Latest edition:

.1 CSA G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 CSA-S16, Limit States Design of Steel Structures.

.3 CSA W47.1, Certification of Companies for Fusion Welding of Steel.

.4 CSA W48, Filler Metals and Allied Materials for Metal Arc Welding.

.5 CSA W55.3, Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.

.6 CSA W59, Welded Steel Construction (Metal Arc Welding).

.4 The Society for Protective Coatings (SPC) and National Association of Corrosion Engineers (NACE) International 299:

.1 SSPC-SP3, Power Tool Cleaning.

.2 SSPC SP6/ NACE No. 3, Commercial Blast Cleaning.

.3 SSPC-PA 1, Shop, Field, and Maintenance Painting of Steel.

1.2 Action and Informational Submittals

.1 Submit in accordance with Submittal Procedures set out in Division 1. “Engineered” denotes Shop Drawing submittal requirements and shall be prepared, signed and sealed by a (Specialty) professional structural engineer registered or licensed in Province of Manitoba, Canada and having a minimum of five (5) years proven experience in this type of Work.

.1 Specialty Engineer to submit Certification Letter of Assurance of “professional design” and commitment for “field review” which shall be included with the Shop Drawing submittals.

.2 Structural Calculations:

.1 Submit structural calculations sealed by the Specialty Engineer. This shall include:

.1 Description of design criteria adopted.

.2 Summary of engineering analysis showing maximum stresses and deflections.

.2 Erection drawings:

.1 Prepare and submit erection drawings in PDF format for the Contract Administrator’s review based on issued for construction drawings to show:

.1 General arrangement with principal dimensions of the structures.

.2 Elevation and detail sections.

.3 Piece marks and sizes of members.

.4 Size, number and type of bolts for the connections.

.5 Necessary dimensions and details for setting anchor rods.

.2 Submit an assurance letter stamped and signed by the Specialty Engineer.

.3 Connection Details:

.1 Prepare, design and submit connection design details in advance of the shop details to the Contract Administrator for confirmation that the design intent is met based on the structural layout and connection forces shown on the construction drawings – See item 2.1 (Design requirements). The design details are to include both standard and non-standard connections and are to be referenced to the design drawings and/or erection drawings.

.4 Shop Details:

.1 Prepare and submit for record shop details based on the issued construction drawings, the accepted erection drawings and connection design details. The shop

details shall be complete with information necessary for fabrication of various members and components of the structure including:

.1 Material grade and standards.

.2 Member size and geometry.

.3 Details and sections.

.4 Connection: mechanical fasteners and welds.

.5 Location, type and size of all attachments.

.5 Field Work Details:

.1 Where fabricated members require modification on the job site, submit field work details to the Contract Administrator for review and prior approval. The details are to be stamped and signed by the Specialty Engineer.

.6 Source Quality Control Submittals:

.1 Submit PDFs of mill test reports:

.1 Mill test reports to show chemical and physical properties and other details of steel to be incorporated in project.

.2 Where requested, provide mill test reports certified by metallurgists qualified to practice in the Province of Manitoba, Canada.

.7 Certification Letter of Assurance:

.1 Ensure that relevant assurance letters stamped and signed by the Specialty Structural Engineer have been submitted to Contract Administrator. The letter(s) shall state that:

.1 The connections and components delegated to the specialty engineer are engineered in conformance with the project requirements;

.2 Materials and products used in fabrication conform to applicable material and products standards specified and indicated.

.3 Fabrication and installation of all structural steel components will be reviewed by the specialty engineer to ensure that all components have been fabricated and erected in accordance with the reviewed Shop Drawings to the specified tolerance and the applicable standards.

.3 Field Review and Inspection Reports:

.1 Specialty Engineer to submit Certification Letter or Letter of Assurance of “professional field review” and “compliance” in accordance with the agreed Field Quality Control. Inspection reports to be issued to the Contract Administrator and structural engineer of record concurrently at each inspection.

1.3 Delivery, Storage and Handling

.1 Delivery and Acceptance Requirements: Deliver steel in accordance with same label marks as used for fabrication and erection documents.

.2 Storage and Handling Requirements: Protect steel from corrosion, deformation and other damage during site storage and handling. Protect other sections of the Work from damage by this Section.

2. PRODUCTS

2.1 Design Requirements

.1 Design details and connections in accordance with requirements of CSA-S16 to resist forces, moments, shears and allow for movements indicated.

.2 Shear connections: When forces not indicated.

.1 Select framed beam shear connections from an industry accepted publication such as “Handbook of the Canadian Institute of Steel Construction” when connection for shear only (standard connection) is required.

.2 Select or design connections to support reaction from maximum uniformly distributed load that can be safely supported by beam in bending, provided no point loads act on beam, when shears are not indicated.

.3 Submit sketches and design calculations stamped and signed by qualified Professional Engineer licensed in the Province of Manitoba, Canada for non-standard connections.

2.2 Materials

.1 Structural steel: to CSA-G40.20/G40.21 with minimum grade as per Drawings.

.2 Steel Plates: to CSA G40.21; Type 300W.

.3 Anchor bolts: to ASTM F 1554, Grade 36 (with minimum yield strength = 248 MPa and tensile strength = 400 Mpa).

.4 Bolts, nuts and washers: to ASTM A 325M, A563M and F436M.

.5 Welding materials: to CSA W59 and certified by Canadian Welding Bureau.

.6 Shop paint primer: to CGSB-1.40 or CGSB-1.181.

.7 Shop galvanizing: Hot dip galvanizing: galvanize steel, where indicated, to CSA-G164, minimum zinc coating of 600 g/m^2.

.8 Shear studs: to CSA W59, Appendix H.

.9 Touch-up paint and primer: Maximum VOC: 150 g/L (less water).

2.3 Fabrication

.1 Fabricate structural steel in accordance with CSA-S16 and in accordance with reviewed Shop Drawings.

.2 Seal all hollow structural sections with suitable cap plates or by welding all around to adjoining members.

.3 Provide 10 mm plate stiffeners each side of beam where continuous over supports.

.4 Provide 10 mm plate stiffener each side of beam at all bearing connections.

.5 Camber horizontal members to accommodate dead load deflection.

.6 Provide welds smooth and groove welds flush on exposed structural steel; file or grind as required.

.7 All steel shall receive shop coat of primer except surfaces to be concreted, welded, light zinc coated or galvanized.

.8 Hot Dip Galvanize where indicated all structural steel and attached components to ASTM A123M for shapes and ASTM A153 for hardware.

.9 Do not place any holes or openings in structural steel members.

.10 All exposed steel to be galvanized.

3. EXECUTION

3.1 Application

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

3.2 General

.1 Structural steel work: in accordance with CSA-S16 (Latest edition).

.2 Welding: in accordance with CSA W59.

.3 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3 for resistance welding of structural components.

3.3 Marking

.1 Mark materials in accordance with CSA G40.20/G40.21. Do not use die stamping. When steel is to be left in unpainted condition, place marking at locations not visible from exterior after erection.

.2 Match marking: shop mark bearing assemblies and splices for fit and match.

3.4 Erection

.1 Erect structural steel, as indicated and in accordance with CSA-S16 and in accordance with reviewed erection drawings.

.2 Make adequate provision for all erection loads and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of necessary permanent bracing.

.3 Set column base plates on steel wedges or shims to accurate elevations. Wooden wedges are not permitted.

.4 Do not field cut or alter structural members. Report to the Contract Administrator every failure of material to fit together properly. Corrective measures to be approved by the Contract Administrator.

.5 Continuously seal members by continuous welds where indicated. Grind smooth.

.6 Repair damaged galvanizing to ASTM A780M with zinc-rich paint equivalent to Galvacon applied in multiple coats to a minimum dry film thickness of 0.20 mm.

.7 Clean all field welds, bolted connections and abraded areas. Apply touch up shop primer (or zinc rich paint per item 6 for galvanized steel) to bolts, welds and burned or scratched surfaces at completion of erection.

3.5 Field Quality Control

.1 Inspection and testing of materials and workmanship will be carried out by testing laboratory designated by Contract Administrator and paid for by the Contractor.

.2 The Inspection and Testing Company will carry out vertical and horizontal alignment checks, torque testing and inspection of bolted and welded connections for a minimum 10% representative sample of connections. Welding inspections to be visual, except where non-destructive testing is deemed necessary by the Testing Agency or Contract Administrator.

.3 Welds are to be considered defective if they fail to meet quality requirements of CSA W59.

.4 Test shear studs in accordance with CSA W59.

.5 Provide safe access and working areas for testing on Site, as required by testing agency and as authorized by Contract Administrator.

.6 Submit test reports to Contract Administrator within one (1) week of completion of inspection.

3.6 Defective Works

.1 Remove and replace, or repair, damaged or defective work, at no cost to the City.

.2 Contractor shall be responsible for the cost of additional testing and re-inspection made necessary by the occurrence of deficient Work.

.3 Submit in writing details of proposed method of remedial work, for approval by the Contract Administrator. Details to be signed and sealed by a licensed Professional Engineer retained by the Contractor.

.4 Correction of misaligned holes or other field modifications by flame-cutting is not permissible.

3.7 Cleaning

.1 Clean work area at job Site.

END OF SECTION

METAL FABRICATIONS

1. GENERAL

1.1 Work Included

.1 Shop fabricated ferrous metal items with galvanized finish unless noted otherwise. The following is a list of principal items only. Refer to Drawing details for items not specifically listed.

.1 Anchors, bolts, nuts, screws, brackets, etc., required for Work of this Section.

.2 Monorail beam and support frames.

.3 Bollards.

.4 Veneer support steel.

.5 Loose angle at masonry openings.

.6 Embed plates.

.7 Masonry wall top supports.

.8 Cable tray support frames.

.9 Stairs and railings.

.10 Platforms and guardrails.

.11 Safety tie-off Anchors.

.12 Steel Pan Treads.

1.2 Design Code, Quality Assurance

.1 Perform welding in accordance with requirements of CSA W59.

.2 Welding work on all load carrying structures and assemblies is to be performed by a firm certified by the Canadian Welding Bureau to the requirements of CSA W47.1 in Division 2.

.3 All welders employed to weld load carrying structures in the field are to possess valid "S" Classification Class "O" certificates issued by the Canadian Welding Bureau except for floor and roof hatches.

.4 Design details and connections to requirements of CSA-S16 to resist forces, moments and shears indicated.

.1 Where forces not indicated:

.1 Unless beam supports concentrated loads, design beam connections to support reactions from maximum uniformly distributed load that can be safely supported by beam in bending.

.2 Where beam supports concentrated loads, request design reactions from Contract Administrator.

.2 Bolts shall be bearing type.

1.3 Shop Drawings

.1 Submit Shop Drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Clearly indicate profiles, sizes, connections, attachments, reinforcing, anchorage, size and type of fasteners, and accessories.

.3 Include erection drawings, elevations, and details where applicable.

.4 Indicate welded connections using CISC standard welding symbols. Clearly indicate net weld lengths.

.5 Shop Drawings and design briefs are to bear the seal of a Professional Engineer registered in the Province of Manitoba.

1.4 Inspection and Testing

.1 Shop and field inspection and testing, when required by the Contract Administrator, will be performed by an Inspection and Testing Firm appointed and paid by the City.

.1 Magnetic particle inspection of welds will be performed by the Inspection and Testing Firm, in accordance with CSA W59 and ASTM E709.

.2 Welds are to be considered defective if they fail to meet quality requirements of CSA W59.

.3 Provide free access to all portions of Work in the shop and in the field and cooperate with appointed firm.

.4 Pay all additional costs for inspection and re-inspection due to defective workmanship or materials.

.5 Visually inspect all welds.

.6 Submit mill test reports, properly correlated to materials actually used.

2. PRODUCTS

2.1 Materials

.1 Structural channels, angles, plates, and miscellaneous steel: conforming to CSA G40.21; Type W with minimum yield strength of 300 MPa.

.2 Hollow structural sections: conforming to CSA G40.21, Grade 350W Class ’C’ with minimum yield strength of 350 MPa. Hollow structural sections conforming to ASTM A500 Grade C will not be acceptable.

.3 Structural steel wide flange sections (W shapes): conforming to CSA G40.21, grade 350W with minimum yield of 350 MPa, or conforming to ASTM A992 or A572, grade 50 with minimum yield of 345 MPa.

.4 Bollards: conforming to ASTM A53, DN 150 XS (Schedule 80).

.5 Welding materials: conforming to CSA W59.

.6 Concrete anchors: as manufactured by Hilti (Canada) Ltd. or approved equal in accordance with B7 where indicated.

.1 Grouted Masonry wall: Hilti HAS threaded rod with HIT-HY 200 adhesive or approved equal in accordance with B7.

.2 Non-grouted Masonry wall: Hilti HAS threaded rod with HIT-HY 70 adhesive and mesh screen or approved equal in accordance with B7.

.3 Solid concrete: Hilti HAS rod with HIT-HY 200 or approved equal in accordance with B7.

.7 Galvanizing for bollards and steel shapes unless noted otherwise: conforming to ASTM A 123/A 123M. Coating Grade 45 (320 g/m^2).

.8 Galvanizing for steel fasteners: conforming to ASTM A 153/A 153M.

.9 Touch-up galvanizing with minimum three (3) coats of zinc rich primer. Colour of primer is to match the colour of galvanizing substrate.

.10 Bolts, nuts, and washers: conforming to ASTM A325 for steel members and stainless-steel Type 316 for connection of stainless steel members.

.11 Veneer Support frame: as manufactured by Fero or approved equal in accordance with B7.

.12 Steel lintel: Hot dip galvanized steel angle, size as shown in the Drawings.

.13 Masonry wall top supports: Hot dip galvanized assembly as shown in the Drawings.

.14 Cable tray support frames: Material assembly as shown in the Drawings.

.15 Stairs and railings: Stairs and railing in stairwell shall be hot dip galvanized assembly as shown in the Drawings.

.16 Platforms and guardrails: Hot dip galvanized assembly as shown in the Drawings.

.17 Safety tie-off anchors in Dewatering Room:

.1 DBI model 2101004 concrete detent anchor assembly; supply only three (3).

.18 Steel Pan Treads: Size as indicated on drawings.

2.2 Shop Painting

.1 Clean all members receiving galvanizing material to SSPC SP SP-10 “Near-White Blast Cleaning”.

2.3 General Fabrication

.1 Verify all dimensions on-site prior to shop fabrication.

.2 Fabricate items of sizes and profiles detailed on Drawings, with joints neatly fitted and properly secured.

.3 Fit and shop assemble in largest practical sections, for delivery to Site.

.4 Supply all components required for proper anchorage of miscellaneous metals. Fabricate anchorage and related components of same material and finish as metal fabrications, unless otherwise specified or shown.

.5 Weld connections where possible, otherwise bolt connections.

.6 Accurately form all connections and joints with exposed faces flush, mitres and joints tight.

.7 Exposed welds and metal sections shall be smooth and flush; grind or file as required.

.8 Provide for flush welded or hairline butt field joints.

.9 Shop fabricate openings in members for other building components. Reinforce openings to restore member to original design strengths.

.10 Provide lugs, clips, brackets, hangers, and struts as required for attaching miscellaneous metal items securely to building structure.

3. EXECUTION

3.1 Examination

.1 Before starting erection, examine other Work that may affect this Work.

.2 Notify the Contract Administrator of any conditions that would prejudice proper installation of this Work.

.3 Commencement of erection Work implies acceptance of existing conditions.

3.2 Erection

.1 Obtain the Contract Administrator’s permission prior to site cutting or making adjustments that are not part of scheduled Work.

.2 Install items plumb, square, and level, fitted accurately and maintain free from distortion or defects detrimental to appearance and performance.

.3 Make provision for erection stresses and temporary bracing. Keep Work in alignment at all times.

.4 Replace items damaged in course of installation.

.5 Perform required field welding. Exposed welds shall be smooth and flush; grind or file as required.

.6 Perform necessary cutting and altering for the installation of Work of other Sections, and as indicated on Drawings. No additional cutting shall be done without the permission of the Contract Administrator.

.7 Perform all field assembly bolting and welding to match standard of shop bolting and welding. Bolts and screws are to be concealed whenever possible.

.8 After installation, touch-up field bolts, nuts, welds, and scratched and damaged primed surfaces.

.9 Supply, to appropriate sections, items required to be cast into concrete, complete with necessary setting templates.

END OF SECTION

1. GENERAL

1.1 Work Included

.1 Shop fabricated aluminum items unless noted otherwise. The following is a list of principal items only. Refer to Drawing details for items not specifically listed.

.1 Stairs and railings.

.2 Gratings.

.3 Guardrails.

.4 Opening frame and covers.

.5 Anchors, bolts, nuts, screws, brackets, etc., required for Work of this Section.

1.2 Design Code, Quality Assurance

.1 Perform welding in accordance with requirements of CSA W59.2.

.2 Perform aluminum design in accordance with CSA S157.

.3 Welding work on all load carrying structures and assemblies is to be performed by a firm certified by the Canadian Welding Bureau to the requirements of CSA W47.2 in Division 2.

.4 All welders employed to weld load carrying structures in the field are to possess valid "S" Classification Class "O" certificates issued by the Canadian Welding Bureau except for floor and roof hatches.

.5 Design and fabricate stairs, landings, handrails, guardrails, and balustrades to conform to requirements of the National Building Code of Canada 2010 and Manitoba Amendments.

.6 Design and fabricate floor opening checkered cover plate and support frames for loads as shown on the drawings. Provide design for easy removal of the intermediate support frames and cover plates.

1.3 Shop Drawings

.1 Submit Shop Drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Clearly indicate profiles, sizes, connections, attachments, reinforcing, anchorage, size and type of fasteners, and accessories.

.3 Include erection drawings, elevations, and details where applicable.

.4 Indicate welded connections using CISC standard welding symbols. Clearly indicate net weld lengths.

.5 Shop Drawings and design briefs are to bear the seal of a Professional Engineer registered in the Province of Manitoba (Construction Contractor’s Professional Engineer).

1.4 Inspection and Testing

.1 Welds shall be considered defective if they fail to meet quality requirements of CSA W59.2.

.2 Pay all additional costs for inspection and re-inspection due to defective workmanship or materials.

.3 Visually inspect all welds.

.4 Submit mill test reports, properly correlated to materials actually used.

2. PRODUCTS

2.1 Materials

.1 All materials shall be new.

.2 Aluminum to requirements of CSA-S157, 6061-T6 or 6063-T6 aluminum alloy. All aluminum shapes to be anodized in accordance with Aluminum Association Standard SSA-46, designation A41, clear (natural) coating, Architectural Class 1, 18 µm (0.007 mils).

.3 Aluminum grating: to style 30-102M as manufactured by Fisher & Ludlow or approved equal in accordance with B7 using 6063-T6 aluminum alloy for bearing bars and 6063-T5 aluminum alloy for cross bars. Provide serrated grating for exterior applications. Provide stainless steel Type D hold down clips; Type C may be used if Type D is impractical.

.4 Aluminum stair treads: to style Type A-Checker Plate Nosing, width 278 mm wide as manufactured by Fisher & Ludlow or approved equal in accordance with B7 using 6063-T6 aluminum alloy for bearing bars and 6063-T5 aluminum alloy for cross bars. Provide serrated grating for exterior applications.

.5 Fastening devices connecting aluminum parts to aluminum, concrete, or other materials: stainless steel bolts to ASTM F 593, stainless steel nuts to ASTM F 594, with appropriate isolation devices; Type 316.

.6 Welding materials: conforming to CSA W59.2.

.7 Bituminous paint: to MPI (Master Paint Institute) EXT 5.5D, without thinner.

.8 Concrete anchors: stainless steel as manufactured by Hilti (Canada) Ltd. or approved equal in accordance with B7 where indicated.

2.2 General Fabrication

.1 Verify all dimensions on-site prior to shop fabrication.

.2 Fabricate items of sizes and profiles detailed on Drawings, with joints neatly fitted and properly secured.

.3 Fit and shop assemble in largest practical sections, for delivery to Site.

.4 Supply all components required for proper anchorage of Work.

.5 Provide bolted connections wherever possible. Bolted connections shall be bearing-type connections with the thread excluded from the planes of shear. Welded connections will not be permitted unless acceptable to the Contract Administrator. Inform Contract Administrator if required welding procedures will negatively influence the original yield strength of the members at the compression or tension flange. Adjust welding procedures as required by the Contract Administrator at no additional cost.

.6 Accurately form all connections and joints with exposed faces flush, mitres and joints tight.

.7 Exposed welds where necessary shall be smooth and flush; grind or file as required.

.8 Provide banding at discontinuous edges of grating and around all penetrations.

.9 Provide banding of same size as bearing bars for all required openings through grating as required unless noted. Construction Contractor to coordinate location of openings prior to Shop Drawing submission.

.10 Match position of bearing bars and cross bars in adjacent panels to preserve a continuous appearance.

.11 Provide removable hold down clip style Type D complete with appurtenances for all grating. At locations were Type D clip is impractical, provide Type C clip.

.12 Provide minimum two (2) hold-down clips at each end of the panels if not detailed on the Drawings.

.13 Clip adjacent grating panels edges together at maximum 1500 mm spacing to prevent differential vertical movement.

.14 Provide checker plate nosing along grating sections within areas of stairs for width of stair opening.

.15 Shop fabricate openings in members for other building components. Reinforce openings to restore member to original design strengths.

.16 Provide lugs, clips, brackets, hangers, and struts as required for attaching miscellaneous items securely to building structure.

3. EXECUTION

3.1 Examination

.1 Before starting erection, examine other Work that may affect this Work.

.2 Notify the Contract Administrator of any conditions that would prejudice proper installation of this Work.

.3 Commencement of erection Work implies acceptance of existing conditions.

3.2 Erection

.1 Obtain the Contract Administrator's permission prior to site cutting or making adjustments that are not part of scheduled Work.

.2 Install items plumb, square, and level, fitted accurately and maintain free from distortion or defects detrimental to appearance and performance.

.3 Make provision for erection stresses and temporary bracing. Keep Work in alignment at all times.

.4 Replace items damaged in course of installation.

.5 Perform necessary cutting and altering for the installation of Work of other Sections, and as indicated on Drawings. No additional cutting shall be done without the permission of the Contract Administrator.

.6 Perform all field assembly bolting to match standard of shop bolting.

.7 After installation, touch-up field bolts, nuts, welds, and scratched and damaged primed surfaces.

.8 Supply, to appropriate sections, items required to be cast into concrete, complete with necessary setting templates.

END OF SECTION

ROUGH CARPENTRY

1. GENERAL

1.1 Work Included

.1 Wood framing and related appurtenances.

.2 Blocking in walls and ceilings.

.3 Concealed wood blocking for support of items and equipment supported by walls and ceiling.

.4 Plywood backer boards for Electrical, Mechanical and Process Works.

.5 Wood treatment.

1.2 References

.1 NLGA - Standard Grading Rules for Canadian Lumber.

.2 CSA O121M - Douglas Fir Plywood.

.3 CSA O141 - Softwood Lumber.

.4 CSA O151M - Canadian Softwood Plywood.

1.3 Quality Assurance

.1 Lumber grading agency: NLGA members accredited by the Canadian Lumber Standards Accreditation Board (CLSAB) and by the American Lumber Standard Committee, Delivery, Storage, and Handling.

1.4 Delivery, Storage, and Handling

.1 Protect Products of this Section under waterproof coverings.

2. PRODUCTS

2.1 Materials

.1 Interior of the Building:

.1 Softwood lumber: CSA O141, non-structural light grading 19% maximum moisture content.

.2 Interior plywood behind gypsum board: CSA O151M - softwood type; Sheathing Panel.

.3 Interior plywood backer boards: CSA O121M - Douglas fir CSA O151M - sanded both sides.

.4 Exterior Void Protection: pressure treated exterior plywood and lumber shall conform to CSA O80, Use Category UC4 utilizing:

.1 CSA O121M - Douglas fir CSA O151M material or Softwood lumber CSA O141.

.5 Galvanizing for steel shapes: conforming to ASTM A 123/A 123M.

.6 Galvanizing for steel fasteners: conforming to ASTM A 153/A 153M.

3. EXECUTION

3.1 Wood Treatment

.1 Wood preservative pressure treatment: CSA O80M using waterborne preservative with 0.30% retainage, manufactured by Wolman.

3.2 Site Applied Wood Treatment

.1 Apply preservative treatment in accordance with CSA O80M Manufacturer's instructions.

.2 Treat Site-sawn ends.

.3 Allow preservative to cure prior to erecting members.

3.3 Installation

.1 Erect wood framing members level and plumb.

.2 Space framing and furring as noted on the Drawings.

.3 Provide blocking, sized to suit, for support of surface mounted accessories and equipment.

.4 Place miscellaneous blocking, furring, strapping, canting, nailing strips, framing and sheathing where indicated on Drawings and as required for secure support of anchorage of other specified materials. Place members true to lines and levels. Secure rigidly in place.

.5 Coordinate the installation of bucks, anchors, blocking, which is to be placed in or behind partitions. Allow such items to be installed after partition framing is complete. Ensure that allowance is made for thickness of wall finish to be applied.

.6 Utilize galvanized (hot-dip) fasteners throughout.

.7 Place sheathing with end joints staggered. Secure sheets over firm bearing. Maintain minimum 1.5 mm and maximum 3 mm spacing between joints on walls and ceilings. Place perpendicular to framing members.

END OF SECTION

PLASTIC FABRICATIONS

1. GENERAL

1.1 Work Included

.1 Supply, and installation of fibreglass reinforced plastic (FRP) support members, grating and accessories.

1.2 Submittals

.1 Submit Shop Drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Design of the (FRP) structural support members, grating and accessories shall be performed by a Professional Engineer registered in the Province of Manitoba (Contractor's Engineer). The Contractor's Engineer doing the design shall review the in-place installation and certify in writing that the work is in conformance with her/his design.

.1 Use loads, load combinations, and stress levels for design in accordance with the National Building Code of Canada (NBCC) 2010 and Manitoba Amendments.

.3 Include erection drawings, elevations, and details.

.4 Submit one (1) sample of each type of grating.

1.3 Quality Assurance

.1 The installation Contractor shall be an erector approved by the Manufacturer.

1.4 Delivery, Storage and Handling

.1 Manufactured materials shall be delivered stored and handled in accordance with Manufacturer's instructions.

2. PRODUCTS

2.1 Materials

.1 Grating:

.1 Acceptable product Fibergrate Vi-Corr by Fibergrate Composite Structures Inc., colour dark gray, top surface: Applied Grit Top.

.2 FRP support members: Dynaform in VEFR vinyl ester resin by Fibergrate Composite Structures Inc., colour dark gray.

.3 FRP Angle: EZ Angle by Fibergrate Composite Structures Inc., colour dark gray.

.4 Hold-down clips: stainless steel.

.5 All FRP members shall be UV resistant.

3. EXECUTION

3.1 Examination

.1 Before starting erection, examine other Work that may affect this Work.

.2 Notify the Contract Administrator of any conditions that would prejudice proper installation of this Work.

.3 Commencement of erection Work implies acceptance of existing conditions.

3.2 FRP Installation

.1 FRP products shall be installed in accordance with Manufacturer's Shop Drawings and written instructions.

.2 The Construction Contractor shall verify measurements in field for the Work prior to FRP fabrication. Determine correct size and locations of required holes or cutouts from field dimensions before fabrication.

.3 Fabricate and install grating panels such that adjacent panels have perpendicular bars lining up to present a continuous appearance. Clip panels together to prevent differential panel to panel movement.

.4 Gratings shall be fabricated free from warps, twists, or other defects that affect appearance and serviceability.

.5 Hold-down clips shall be provided and spaced with a minimum of four (4) per piece of grating, or as recommended by the Manufacturer. Hold-down clips and related appurtenances shall be stainless steel.

.6 All cuts and abrasions are to be sealed in accordance with the FRP Manufacturer's written instructions.

END OF SECTION

DAMPPROOFING

1. GENERAL

1.1 Applicator

.1 All Work shall be done by an experienced, competent dampproofing applicator licensed and/or approved by the dampproofing material Manufacturer. Submit the Manufacturer's certification of this approval along with a list of similar projects and references where the proposed Construction Contractor has installed the same dampproofing systems.

.2 Applicator's installation equipment and methods shall be approved by dampproofing material manufacturer. Submit proof of this approval.

1.2 Schedule of Dampproofing

.1 Apply dampproofing to protect dry and wet areas below grade, including:

.1 All around the exterior concrete walls, exterior tops of slabs and exterior edges of slabs.

.2 Where dampproofing is discontinued, extend dampproofing 1 m beyond the required location.

.3 Confirm locations and details with the Contract Administrator prior to proceeding with dampproofing.

.4 Submit a dampproofing work plan will all locations and details a minimum of three (3) weeks prior to proceeding with dampproofing.

1.3 Submittals

.1 At the early stages of the project, well before any intended dampproofing activity on site, submit the following information for the Contract Administrator 's review:

.1 Product manufacturer's written approval of the proposed dampproofing Construction Contractor.

.2 List of reference contacts and similar projects completed by the proposed Construction Contractor using the same dampproofing products.

.3 Product samples and manufacturer's technical literature for materials and application procedures.

.2 Submit details of the proposed dampproofing systems for each area. Include material data sheets, layer sequence and thickness, surface preparation and acceptance criteria, and protection criteria.

.3 Submit the dampproofing manufacturer's instructions and details for application, membrane thickness, number of layers, cant beads, protection board, expansion joints, cracks, reinforcing sheets, pipe protrusions, etc.

.4 During the course of the project, immediately prior to commencing work in each area, submit a Letter of Acceptance for the concrete surfaces to be dampproofed, signed by the applicator's authorized representative.

.5 Product manufacturer's representative to inspect the dampproofing Construction Contractor's work on a regular basis and submit inspection reports to the Contract Administrator.

2. PRODUCTS

2.1 For Exterior Use

.1 Hydrotech Monolithic Membrane 6125 (MM6125) system as manufactured by American Hydrotech Inc:

.1 Primer: as required by dampproofing manufacturer.

.2 Membrane: one (1) 4.8 mm WFT layer.

.2 Henry/Bakor 790-11 system as manufactured by Henry Company:

.1 Primer: as required by dampproofing manufacturer.

.2 Membrane: one (1) 2.3 mm WFT layer of membrane. Apply reinforcing sheet and embed into first layer of membrane. Apply one (1) additional 3.2 mm WFT layer of membrane over reinforcing sheet.

.3 Dampproofing Protection Board: asphalt impregnated fiber board to dampproofing manufacturer’s thickness recommendations.

3. EXECUTION

3.1 General

.1 Deliver materials to job Site in factory sealed containers with manufacturer's identification of each package.

.2 Store materials in a weatherproof environment to prevent damage or deterioration.

3.2 Surface Preparation, Inspection, and Certification for Concrete Substrates

.1 As an initial step, clean all surfaces to be dampproofed of any and all deleterious material.

.2 Inspect all subject surfaces to identify imperfections including, but not limited to, uneven surfaces, joints, cracks, honeycombing, spalls, delaminated areas, exposed reinforcing steel, or any other existing conditions that may affect the performance of the new dampproofing system.

.3 Repair cracks in concrete using polyurethane or epoxy injection. After injection, remove any related coatings or injection nipples and prepare the surfaces affected at no cost to the City.

.4 Repair other surface imperfections and surfaces of cracks by chipping out and filling with repair mortar to the satisfaction of the Contract Administrator and the dampproofing materials manufacturer prior to beginning final surface preparation steps.

.5 Blast clean all surfaces to a dry, roughened texture using approved equipment, materials and methods; while adhering to the dampproofing manufacturer's requirements and environmental considerations.

.6 Dampproofing manufacturer's authorized agent to inspect surfaces to be damp proofed with the Contract Administrator and damp proofing Construction Contractor. Provide to the Contract Administrator a written certification from the dampproofing manufacturer that the surfaces are acceptable for the application of the dampproofing system, and that the proposed dampproofing system is appropriate for the location and required service. Do not apply any damp proofing until the Contract Administrator receives the written certification from the manufacturer.

3.3 Pre-Treatment and Detailing

.1 Ensure the surfaces are approved.

.2 Pre-treat repaired areas with a layer of reinforced coating as recommended by dampproofing manufacturer.

.3 Provide cants, reglets, and edge preparations in accordance with dampproofing manufacturer’s written instructions.

.4 Apply primers as required by dampproofing manufacturer.

3.4 Application of Dampproofing

.1 Conform to the dampproofing manufacturer's instructions and details for application, membrane thickness, number of layers, cant beads, protection board, expansion joints, cracks, reinforcing sheets, bonding of layers, bonding of wall dampproofing to concrete substrate.

.2 Schedule the Work to allow a minimum twenty-eight (28) days curing for new concrete prior to dampproofing.

.3 Apply dampproofing only when atmospheric conditions are suitable. Do not apply during rain or when temperatures are below 10°C. Maintain material and substrate temperatures within limits recommended by product manufacturer. Provide suitable enclosures of areas to be dampproofed if necessary to satisfy the work condition requirements.

.4 Lap joints in dampproofing in accordance with the manufacturer's instructions.

.5 Cure membrane in accordance with the manufacturer's instructions.

.6 Use special designed spray machines where recommended by the manufacturer.

END OF SECTION

THERMAL INSULATION AND BELOW SLAB VAPOUR BARRIER

1. GENERAL

1.1 Work Included

.1 Below-slab vapour barrier.

.2 Fire Stopping Insulation.

2. PRODUCTS

2.1 Materials

.1 Vapour Barrier against cast-in-place concrete (below slab vapour barrier):

.1 Vapour barrier shall meet the permeance as tested after conditioning in accordance with ASTM E 1745 paragraphs 7.1.2 through 7.1.5:

.1 Less than 0.01 perms.

.2 Strength Class A.

.2 Stego Wrap Vapour Barrier 0.38 mm thick (15 mil) by Stego Industries.

.3 Seam Tape for slab on grade: Stego Tape by Stego Industries.

.4 Seam Tape for self-supporting slabs: Stego Crete Claw Tape by Stego Industries.

.5 Mastic for all slab types: Stego Mastic by Stego Industries.

.6 Termination Bar: Stego ‘Term’ Bar by Stego Industries.

.2 Fire Stopping Insulation: mineral fibre, meeting the requirements of ASTM C612, Mineral Fiber Block and Board Thermal Insulation:

.1 Acceptable product:

.1 ROCKWOOL Safe as manufactured by Rockwool Inc.

.3 Acoustical Sealant: One component, non-skinning, non-hardening acoustical sealant as manufactured by Tremco Ltd.

3. EXECUTION

3.1 Vapour Barrier Film Installation for Cast-In-Place Concrete Slabs (Below Slab Vapour Barrier)

.1 Install vapour barrier in accordance with Manufacturer’s written instructions and ASTM E 1643.

.2 Lap vapour barrier to concrete support elements as indicated in the Drawings. Seal joint with mastic and termination bar.

.3 Overlap joints 150 mm and seal with Manufacturer’s tape.

.4 Seal all penetrations.

.5 Repair damaged areas by cutting patches and maintaining a minimum 150 mm lap around the perimeter of the patched area. Seal all sides with manufacture’s tape.

3.2 Fire Stopping Insulation Workmanship

.1 Install insulation after building substrate materials are dry.

.2 Install insulation to maintain continuity of sound protection to building elements and spaces.

.3 Fit insulation tight to electrical boxes, plumbing and heating pipes and ducts, around external doors and protrusions.

.4 Install materials in accordance with manufacturer's instructions.

END OF SECTION

RIGID INSULATION AND AIR/VAPOUR BARRIER

1. GENERAL

1.1 Work Included

.1 Cavity Wall, Slab Edge and Perimeter Skirting insulation.

.2 Air/Vapour Barrier.

1.2 References

.1 ASTM D2842; Standard Test Method for Water Absorption of Rigid Cellular Plastics.

.2 ASTM E96/E96M; Standard Test Method for Water Vapor Transmission of Materials.

.3 ASTM E1677; Standard Specification for Air/Vapour Barrier Material or System for Low-Rise Framed Building Walls.

.4 ASTM E2178; Standard Test Method for Air Permeance of Building Materials.

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

1.3 Submittals

.1 Submit 180 mm x 280 mm Sample of Air/Vapour Barrier, through wall flashing and special connections for review.

.2 Submit Samples for review in accordance with Section 01 33 00 – Submittal Procedures.

2. PRODUCTS

2.1 Rigid Insulation

.1 Cavity Wall Rigid Insulation: 125 mm thick rigid insulation CAN/ULC-S701, Type 4 rigid, closed cell type, with integral high density skin, extruded polystyrene insulation, 610 mm wide x 2440 mm long, edge treatment: butt edge and ship lapped. As manufactured by Dow Chemical or Celfortec.

.2 Perimeter Skirting Insulation: 100 mm thick HI-40.

2.2 Grade Beam Insulation

.1 CFI Panel: 100 mm thick rigid insulation complete with factory applied concrete facing, CAN/ULC-S701, Type 4 rigid closed cell type, extruded polystyrene insulation, 610 mm wide x 1220 mm long; Concrete Faced Insulation Wall Panels (CFI) as manufactured by T. Clear Corporation.

.2 Anchorage: Purpose made galvanized steel securement clips as manufactured by T. Clear Corporation.

2.3 Air/Vapour Barrier

.1 Membrane type: Self-adhesive: SBS modified bitumen membrane reinforced with cross-laminated polyethylene film; 1 mm thick minimum; Blueskin SA by Henry Company or Aquabarrier AVB by IKO. Primer to membrane manufacturer's recommendations. Sealant: To membrane manufacturer's recommendations.

.2 Acrylic Self Adhering Air & Vapour Barrier:

2.4 Through Wall Flashing

.1 Membrane type: Self-adhesive: SBS modified bitumen membrane reinforced with cross-laminated polyethylene film; 1 mm thick minimum; Blueskin TWF by Henry Company. Primer to membrane manufacturer's recommendations. Sealant: To membrane manufacturer's recommendations.

.2 Acrylic Self Adhering Air & Vapour Barrier:

2.5 Spray Foam Insulation

.1 Spray Foam Insulation: closed-cell foam with water-resistant outer skin when cured, Great Stuff as manufactured by Dow Chemical. Low expansion for windows and doors.

2.6 Insulation Adhesive

.1 Adhesive: type recommended by insulation manufacturer.

2.7 Adhesive and Primer for Air/Vapour Barrier

.1 Adhesive and Primer: type recommended by Air/Vapour Barrier manufacturer.

3. EXECUTION

3.1 Preparation

.1 Verify substrate and adjacent materials and insulation boards are dry.

.2 Verify insulation boards are unbroken, free of damage, with face membrane undamaged.

.3 Verify surfaces within walls being insulated have been inspected and accepted.

3.2 Rigid Insulation

.1 Apply adhesive to secure above grade rigid insulation to substrate.

.2 Apply adhesive to secure below grade insulation to substrate and provide mechanical anchorage to substrate utilizing Retainer Tee Stud and related anchors.

.3 Butt edges and ends tight to adjacent board and protrusions.

.4 Spray foam voids between rigid insulation sheet joints.

.5 Adhere insulation to substrate using adhesive in accordance with the insulation manufacturer's written instruction.

.6 Stagger joints between adjacent rows and layers of rigid insulation.

3.3 Grade Beam Insulation

.1 Install CFI Wall Panels with 1220 mm edge horizontal.

.2 Install purpose made anchors and side flashings.

3.4 Installation – Air/Vapour Barrier

.1 Install Air/Vapour Barrier over substrate in accordance with manufacturer's recommendations.

.2 Install Air/Vapour Barrier prior to installation of doors and mechanical louvers.

.3 Start Air/Vapour Barrier installation at a building corner, leaving 150 mm to 300 mm of Air/Vapour Barrier extended beyond corner to overlap.

.4 Install Air/Vapour Barrier in a horizontal manner starting at the lower portion of the substrate with subsequent layers installed in a shingling manner to overlap lower layers. Maintain Air/Vapour Barrier plumb and level.

.5 Door openings and wall penetrations: Extend Air/Vapour Barrier completely over openings.

.6 Extend and lap to wall vapour barrier to maintain the building envelope.

.7 Extend and lap to dampproofing to maintain the building envelope.

.8 Overlap Air/Vapour Barrier:

.1 Seams: minimum 150 mm.

3.5 Installation – Through Wall Flashing

.1 Install Through Wall Flashing to lap Air/Vapour Barrier and metal flashing material.

.2 Install continuous sealant at discontinuous edges of Through Wall Flashing.

END OF SECTION

SPRAYED POLYURETHANE FOAM INSULATION

1. GENERAL

1.1 Work Included

.1 Description of Work:

.1 Spray application of medium-density, closed-cell polyurethane foam insulation to provide continuous thermal insulation and air/vapour barriers to substrates indicated on Drawings and specified herein.

1.2 References

.1 American Society for Testing and Materials (ASTM):

.1 ASTM C518-10: Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

.2 ASTM E84-12b: Test Method for Surface Burning Characteristics of Building Materials.

.3 ASTM E96-10: Standard Test Methods for Water Vapor Transmission of Materials.

.4 ASTM E283-04(2012): Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

.2 Underwriters Laboratories of Canada (ULC):

.1 CAN/ULC S705.1, Standard for Thermal Insulation - Spray-applied Rigid Polyurethane Foam, Medium Density: Material Specification.

.2 CAN/ULC S770-09, Standard Test Methods for Determination of Long-term Thermal Resistance of Closed-Cell Thermal Insulating Foams.

1.3 Submittals

.1 Submit product data sheets for review in accordance with Section 01 33 00 – Submittal Procedures.

.1 Product data sheets testing shall be performed by a qualified third-party testing agency evidencing compliance of insulation products with specified requirements including those for thermal resistance, fire-test-response characteristics, water-vapor transmission, and other properties, based on comprehensive testing of current products.

.2 Manufacturer’s certificate certifying insulation provided meets or exceeds specified requirements.

.3 Installer’s certificate showing manufacturers installation certification for quality assurance.

.4 Installer’s proof of experience with a minimum of five (5) years continuous Canadian experience in successful installations.

.5 Tests must be conducted daily on both core density and cohesion/adhesion to the substrate, following procedures established by the manufacturer. The results of these tests must be entered in the daily report forms provided by the Contractor and submitted to the Contract Administrator.

1.4 Quality Assurance

.1 Contractor executing Work of this Section shall have a minimum of five (5) years continuous Canadian experience in successful installations. Submit proof of experience to Contract Administrator in accordance with Section 01 33 00 – Submittal Procedures.

.2 Single Source Responsibility: Single source product from one manufacturer.

.3 The insulating material must be applied by personnel who are certified by manufacturer. These certified individuals must have their certification cards in their possession and available for presentation upon request by the Contract Administrator.

.4 A copy of the Sprayed Polyurethane Foam Insulation manufacturers installation manual or guide for the application of sprayed on polyurethane foam shall be kept on Site.

.5 Conducted daily test on both core density and cohesion/adhesion to the substrate, following procedures established by the Sprayed Polyurethane Foam Insulation Manufacturer. The Contractor shall provide the results of these tests in a daily report submitted to the Contract Administrator in accordance with Section 01 33 00 – Submittal Procedures for each day the material is being applied.

.6 Toxicity/Hazardous Materials:

.1 Provide products that contain no urea-formaldehyde.

.2 Provide products that contain no PBDEs.

.3 Provide products that are “Low-emitting”.

1.5 Sequencing and Scheduling

.1 Co-ordinate the Work with installation of associated Works specified under other Specification Sections.

1.6 Delivery, Storage, Handling and Protection

.1 Comply with the Sprayed Polyurethane Foam Insulation Manufacturer’s written instructions for handling and protection prior to and during installation.

.2 Store material as recommended by the Sprayed Polyurethane Foam Insulation Manufacturer written instructions in original, undamaged containers with manufacturers seals and labels intact. During cold weather, store raw materials in heated storage at the Contractor’s expense.

.3 Protect adjacent surfaces and equipment from damage by overspray.

2. PRODUCTS

2.1 Materials

.1 Sprayed Polyurethane Foam Insulation:

.1 CFC free formulation, closed-cell sprayed polyurethane foam type insulation and conforming to CAN/ULC 705.1.

.1 Basis of Design Product: Walltite ECOv3 by BASF, as represented by Building Resource Inc., or ICYNENE MD-C-200 by Icynene Inc.

.2 Provide primers in accordance with manufacturers recommendations if required for surface conditions.

2.2 Equipment

.1 Use equipment as recommended by the Sprayed Polyurethane Foam Insulation Manufacturer for types of applications required.

3. EXECUTION

3.1 Examination

.1 Verify that surfaces and conditions are suitable to accept Work of this Section.

.2 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 of this Section.

.3 Do not commence Work of this Section until defects have been corrected.

.4 Commencement of Work of this Section implies acceptance of surfaces and conditions.

3.2 Preparation

.1 Mask and cover adjacent areas to protect from overspray.

.2 Apply primers for special conditions as required by the Sprayed Polyurethane Foam Insulation Manufacturer written installation instructions.

.3 Clean Work area prior to commencing spray operations.

.4 Coordinate with Work of other Sections.

3.3 Application

.1 Apply sprayed polyurethane foam insulation to clean surfaces in accordance with manufacturers written instructions. Use primers where recommended the Sprayed Polyurethane Foam Insulation Manufacturer.

.2 Thicknesses of sprayed polyurethane foam insulation shall be minimum 70 mm and thicker as indicated on the Drawings, with a maximum tolerance from required thickness of plus or minus 6 mm.

.3 Fill in gaps and spaces around wood supporting members, plywood, metal substrates and other locations with sprayed polyurethane foam insulation to form continuous building envelope.

.4 Bond and lap to existing polyethylene vapour barriers, new air retarder membranes to provide a continuous building envelope.

END OF SECTION

METAL COMPOSITE MATERIAL WALL PANELS

1. GENERAL

1.1 Related Documents

.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 Summary

.1 Section includes metal composite material wall panels.

1.3 Definitions

.1 DBVR: Drained and back-ventilated rainscreen system; rainscreen system designed to drain and dry cavity entering water through drainage channels, weeps, and air ventilation.

.2 MCM: Metal Composite Material; cladding material formed by joining two thin metal skins to polyethylene or fire-retardant core and bonded under precise temperature, pressure, and tension.

1.4 Preinstallation Meetings

.1 Preinstallation Conference: Conduct conference at Project site.

.1 Meet with the City, Architect, City's insurer if applicable, MCM panel Fabricator and Installer, MCM sheet manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects MCM panels, including installers of doors, windows, and louvers.

.2 Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

.3 Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.

.4 Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect MCM panels.

.5 Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.

.6 Review temporary protection requirements for MCM panel assembly during and after installation.

.7 Review procedures for repair of panels damaged after installation.

.8 Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.5 Action Submittals

.1 Product Data: For each type of product.

.1 Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

.2 Shop Drawings:

.1 Include fabrication and installation layouts of MCM panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.

.2 Accessories: Include details of the flashing, trim and anchorage.

.3 Samples for Initial Selection: For each type of MCM panel indicated with factory-applied color finishes.

.1 Include similar Samples of trim and accessories involving color selection.

.4 Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

.1 MCM Panels: (305 mm) long by actual panel width. Include fasteners, closures, and other MCM panel accessories. Submit custom color samples in paint manufacturer's standard size.

1.6 Informational Submittals

.1 Qualification Data: For Installer.

.2 Product Test Reports: For each product, tests performed by a qualified testing agency.

.1 MCM Manufacturer's Material Test Reports: Certified test reports showing compliance with specific performance or third-party listing documenting compliance to comparable code sections IBC 1407.14 and IBC 1703.5.

.2 MCM System Fabricator's Certified System Tests Reports: Certified system test reports showing system compliance with specific performance or third-party listing documenting compliance code section. Base performance requirements on MCM system type provided.

.1 Wet System: Tested to AAMA 501.

.2 DBVR System: Tested to AAMA 509.

.3 PER System: Tested to AAMA 508.

.3 Field quality-control reports.

.4 Sample Warranties: For special warranties.

1.7 Closeout Submittals

.1 Maintenance Data: For MCM panels to include in maintenance manuals.

1.8 Quality Assurance

.1 Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by MCM Fabricator.

.2 Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for MCM fabrication and installation.

.1 Build mock-up of typical MCM panel assembly 1200 x 1200, including supports, attachments, and accessories.

.2 Approval of mock-ups does not constitute approval of deviations from the Contract Documents contained in mock-ups unless Architect specifically approves such deviations in writing.

.3 Subject to compliance with requirements, approved mock-ups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 Delivery, Storage, and Handling

.1 Deliver components, MCM panels, and other manufactured items so as not to be damaged or deformed. Package MCM panels for protection during transportation and handling.

.2 Unload, store, and erect MCM panels in a manner to prevent bending, warping, twisting, and surface damage.

.3 Stack MCM panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store MCM panels to ensure dryness, with positive slope for drainage of water. Do not store MCM panels in contact with other materials that might cause staining, denting, or other surface damage.

.4 Retain strippable protective covering on MCM panels during installation.

1.10 Field Conditions

.1 Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of MCM panels to be performed in accordance with manufacturers' written instructions and warranty requirements.

1.11 Coordination

.1 Coordinate MCM panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.12 Warranty

.1 Warranty on Panel Material: Manufacturer's standard form in which manufacturer agrees to replace MCM that fails within specified warranty period.

.1 Warranty Period: Five (5) years from date of Substantial Completion.

.2 Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace MCM panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

.1 Finish Warranty Period: Ten (10) years from date of Substantial Completion.

2. PRODUCTS

2.1 Performance Requirements

.1 Structural Performance: Provide MCM panel systems capable of withstanding the effects of the following loads, based on testing in accordance with ASTM E330:

.1 Wind Loads: As indicated on Drawings.

.2 Panel Deflection Limit: For wind loads, no greater than 1/60 of the span.

.3 Framing Member Deflection Limits: For wind loads, no greater than 1/240 of the span.

.2 Air Infiltration: Air leakage of not more than (0.3 L/s per sq. m) of wall area when tested in accordance with ASTM E283 at the following test-pressure difference:

.1 Test-Pressure Difference: (300 Pa).

.3 Water Penetration under Static Pressure: No water penetration to room side of assembly when tested for 15 minutes in accordance with ASTM E331 at the following test-pressure difference:

.1 Test-Pressure Difference: (300 Pa).

.4 Thermal Movements: Locate expansion and contraction points to allow for free and noiseless thermal movements from surface temperature changes.

.1 Temperature Change (Range): (-29 to 82.2°C), material surfaces.

.5 Fire Propagation Characteristics: MCM wall assembly passes NFPA 285 testing.

2.2 MCM Wall Panels

.1 MCM Wall Panel Systems: Provide factory-formed and -assembled, MCM wall panels fabricated from two metal facings that are bonded to a solid, extruded thermoplastic core; formed into profile for installation method indicated. Include attachment assembly components, and accessories required for weathertight system.

.1 Basis-of-Design Product: Subject to compliance with requirements, provide ALUCOBOND®; 3A Composites USA Inc.; ALUCOBOND® PLUS or comparable product.

.2 Aluminum-Faced Composite Wall Panels: Formed with (0.50-mm-) thick, anodized aluminum sheet facings.

.1 Panel Thickness: (4 mm).

.2 Core:

.1 Exterior Finish: Color anodized.

.2 Color: As selected by Architect from manufacturer's full range.

.1 Color 1: Statuary Bronze.

.3 Peel Strength: (100 N x mm/mm) when tested for bond integrity in accordance with ASTM D1781.

.4 Fire Performance: Flame spread less than 25 and smoke developed less than 450, in accordance with ASTM E84.

.3 Attachment Assembly Components: Formed from material compatible with panel facing.

2.3 Miscellaneous Materials

.1 Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet ASTM A653/A653M, (Z275 hot-dip galvanized) coating designation. Provide Fabricator's standard sections as required for support and alignment of MCM panel system.

.2 Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of MCM panels unless otherwise indicated.

.3 Flashing and Trim: Provide flashing and trim formed from same material as MCM panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent MCM panels.

.1 Basis-of-Design Product: Subject to compliance with requirements, provide ALUCOBOND®; 3A Composites USA Inc.; ALUCOBOND® Axcent™ Trim or comparable product.

.2 Aluminum Trim: Formed with (1.00 mm) thick, coil-coated aluminum sheet facings.

.3 Color: As selected by Architect from manufacturer's full range.

.1 Color 1: Statuary Bronze.

.4 Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of MCM panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

.5 Panel Sealants: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in MCM panels and remain weathertight; and as recommended in writing by MCM panel manufacturer.

2.4 Fabrication

.1 General: Fabricate and finish MCM panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

.2 Fabricate MCM panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

.3 Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations or recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

.1 Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

.2 Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

.3 Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.

.4 Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.

.5 Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.

.6 Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

.1 Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.5 Finishes

.1 Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

.2 Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

.3 Aluminum Panels and Accessories:

.1 PVDF Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70% PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

.2 FEVE Fluoropolymer: AAMA 2605. One-coat clear fluoropolymer finish containing 100% fluorinated ethylene vinyl ether resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

.3 Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than (0.005 mm) for primer and (0.02 mm) for topcoat.

.4 Exposed Anodized Finish:

.1 Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

3. EXECUTION

3.1 Examination

.1 Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, MCM panel supports, and other conditions affecting performance of the Work.

.1 Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by MCM wall panel manufacturer.

.2 Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by MCM wall panel manufacturer.

.1 Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

.2 Examine roughing-in for components and assemblies penetrating MCM panels to verify actual locations of penetrations relative to seam locations of MCM panels before installation.

.3 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Preparation

.1 Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages in accordance with ASTM C754 and MCM panel manufacturer's written recommendations.

3.3 MCM Panel Installation

.1 General: Install MCM panels in accordance with Fabricator's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports unless otherwise indicated. Anchor MCM panels and other components of the Work securely in place, with provisions for thermal and structural movement.

.1 Shim or otherwise plumb substrates receiving MCM panels.

.2 Flash and seal MCM panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by MCM panels are installed.

.3 Install screw fasteners in predrilled holes.

.4 Locate and space fastenings in uniform vertical and horizontal alignment.

.5 Install flashing and trim as MCM panel work proceeds.

.6 Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.

.7 Align bottoms of MCM panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.

.8 Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

.2 Fasteners:

.1 Aluminum Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.

.3 Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by MCM panel manufacturer.

.4 Attachment Assembly, General: Install attachment assembly required to support MCM wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.

.1 Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.

.5 Panel Installation: Attach MCM wall panels to supports at locations, spacings, and with fasteners recommended by Fabricator to achieve performance requirements specified.

.1 Wet Seal Systems: Seal horizontal and vertical joints between adjacent MCM wall panels with sealant backing and sealant. Install sealant backing and sealant in accordance with requirements specified in Section 07 92 00 "Joint Sealants."

.1 Clip Installation: Attach panel clips to supports at locations, spacings, and with fasteners recommended in writing by Fabricator. Attach routed-and-returned flanges of wall panels to panel clips with Fabricator's standard fasteners.

.2 Panel Installation:

.1 Seal horizontal and vertical joints between adjacent panels with sealant backing and sealant. Install sealant backing and sealant in accordance with requirements specified in Section 07 92 00 "Joint Sealants."

.2 Seal horizontal and vertical joints between adjacent MCM wall panels with Fabricator's standard gaskets.

.3 Joint Sealing: Seal all joints in accordance with AAMA 501.

.2 PER Installation: Install using Fabricator's standard assembly with vertical channel that provides support and secondary drainage assembly, draining at base of wall. Notch vertical channel to receive support pins. Install vertical channels supported by channel brackets or adjuster angles and at locations, spacings, and with fasteners recommended by manufacturer. Attach MCM wall panels by inserting horizontal support pins into notches in vertical channels and into flanges of panels. Leave horizontal and vertical joints with open reveal.

.1 Track-Support Installation: Install support assembly at locations, spacings, and with fasteners recommended by Fabricator. Use Fabricator's standard horizontal tracks and vertical drain channels that provide support and secondary drainage assembly, draining to the exterior at horizontal joints through drain tube. Attach MCM wall panels to tracks by interlocking panel edges with Fabricator's standard "T" clips.

.2 Panel Installation:

.1 Attach routed-and-returned flanges of wall panels to perimeter extrusions with Fabricator's standard fasteners.

.2 Install wall panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.

.3 Joint Sealing: Seal all joints in accordance with AAMA 508. Do not apply sealants to joints unless indicated.

.3 DBVR System: Install using Fabricator's standard assembly with vertical channel that provides support and secondary drainage assembly, draining at base of wall. Notch vertical channel to receive support pins. Install vertical channels supported by channel brackets or adjuster angles and at locations, spacings, and with fasteners recommended by Fabricator. Attach MCM wall panels by inserting horizontal support pins into notches in vertical channels and into flanges of panels. Leave horizontal and vertical joints with open reveal.

.1 Track-Support Installation: Install support assembly at locations, spacings, and with fasteners recommended by manufacturer. Use Fabricator's standard horizontal tracks and vertical [tracks] [drain channels] that provide support and secondary drainage assembly, draining to the exterior at horizontal joints through drain tube. Attach MCM wall panels to tracks by interlocking panel edges with Fabricator's standard "T" clips.

.2 Panel Installation:

.1 Attach routed-and-returned flanges of wall panels to perimeter extrusions with manufacturer's standard fasteners.

.2 Install wall panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.

.3 Joint Sealing: Seal all joints in accordance with AAMA 509. Do not apply sealants to joints unless otherwise indicated.

.6 Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

.1 Install components required for a complete MCM panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by MCM panel Fabricator; or, if not indicated, provide types recommended in writing by MCM system Fabricator.

.7 Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, or SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

.1 Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof performance.

.2 Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of (3 m) with no joints allowed within (605 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than (25 mm) deep, filled with mastic sealant (concealed within joints).

3.4 Erection Tolerances

.1 Site Verifications of Conditions:

.1 Verify conditions of substrate previously installed under other Sections are acceptable for the MCM system installation. Provide documentation indicating detrimental conditions to the MCM system performance.

.2 Once conditions are verified, MCM system installation tolerances are as follows:

.1 Shim and align MCM wall panel units within installed tolerance of (6 mm in 6 m), non-accumulative, on level, plumb, and location lines as indicated, and within (3 mm) offset of adjoining faces and of alignment of matching profiles.

3.5 Field Quality Control

.1 Water-Spray Test: After installation, test area of assembly as directed by Architect for water penetration in accordance with AAMA 501.2.

.2 Fabricator's Field Service: Engage a factory-authorized service representative to test and inspect completed MCM wall panel installation, including accessories.

.3 MCM wall panels will be considered defective if they do not pass test and inspections.

.4 Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

.5 Prepare test and inspection reports.

3.6 Cleaning and Protection

.1 Remove temporary protective coverings and strippable films, if any, as MCM panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of MCM panel installation, clean finished surfaces as recommended by MCM panel manufacturer. Maintain in a clean condition during construction.

.2 After MCM panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

.3 Replace MCM panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SHEET METAL WALL CLADDING

1. GENERAL

1.1 Work Included

.1 Pre-Finished Metal Panels.

1.1 Reference Standards

.1 ASTM A 653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 CRCA – “Canadian Roofing Contractors Association”.

.3 CSSBI Canadian Sheet Steel Building Institute.

.4 Master Paint Institute (MPI).

1.2 Existing Conditions/Protection

.1 Exercise care when working on or about surfaces to avoid damaging or puncturing membrane or flexible flashings.

1.3 Shop Drawings, Submittals

.1 Submit Shop Drawings and Samples for review in accordance with Section 01 33 00 – Submittal Procedures.

.2 Clearly indicate profiles, sizes, connections, attachments, reinforcing, anchorage, size and type of fasteners, and accessories.

.3 Include elevations, and detail drawings where applicable.

.4 Shop Drawings and design briefs are to bear the seal of a Professional Engineer registered in the Province of Manitoba.

.5 Submit 100 mm x 100 mm colour samples for each pre-finished sheet metal cladding and sheet metal liner panel. Submit 100 mm x 100 mm sample for the sheet metal back splash panel.

.6 Submit five (5) screws for securing the sheet metal back splash panel.

1.4 Quality Assurance and Substitutions

.1 Installer to have at least five (5) years’ experience in projects of similar scope and size.

.2 Submit qualifications for review in accordance with Section 01 33 00 – Submittal Procedures.

1.1 Protection

.1 Protect prefinished steel during fabrication, transportation, site storage, and erection in accordance with CSSBI Standards.

2. PRODUCTS

2.1 Sheet Metals

.1 Exterior Wall Panels: Model AWR as manufactured by Behlen Industries LP or model PBR as Manufactured by Robertson Building Systems with nominal profile depth of 32 mm. Minimum 0.498 mm (26 gauge) mm thick pre-finished steel panels. Exterior surface colour: White White QC 8317.

2.2 Sheet Metal Fastening Systems

.1 Metal Wall Panel Cladding and Fascia Cladding: Exposed Fasteners: factory pre-finished, galvanized fastener complete with nylon washer. Fastener colour to match cladding and liner panel to which it is attached.

2.3 Accessory Materials and Components

.1 Bituminous paint: to MPI (Master Paint Institute) EXT 5.5D, without thinner.

2.4 Fabrication

.1 Fabricate all components of the system in the factory, ready for field installation.

.2 All accessories in longest practicable length to minimize field lapping of joints.

.3 Form sections square, true and accurate to size, free from distortion, and other defects detrimental to appearance or performance.

.4 Backpaint flashing with bituminous paint where expected to be in contact with cementitious materials or dissimilar metals.

3. EXECUTION

3.1 Examination

.1 Beginning of installation means acceptance of existing conditions.

3.2 Preparation

.1 Field measure site conditions prior to fabricating Work.

3.3 Exterior Wall Panels:

.1 Install cladding in accordance with Manufacturer’s written installation instructions, providing proper laps and detailing to ensure a weathertight face.

.2 Interlock liner side joints and seal with butyl caulking.

3.4 Paint Remediation

.1 Prepare substrate and remediate damaged coating areas in accordance with the Coating Manufacturer's written instructions to the satisfaction of the Contract Administrator.

3.5 Touch-up and Cleaning

.1 Clean cladding by dry wiping.

END OF SECTION

MODIFIED BITUMINOUS MEMBRANE ROOFING

1. GENERAL

1.1 References

.1 Canadian Roofing Contractors Association (CRCA):

.1 CRCA Roofing Specifications Manual.

.2 Canadian Standards Association (CSA):

.1 CSA A123.21, Standard Test Method for the Dynamic Wind Uplift Resistance of Membrane-Roofing Systems.

.2 CSA A123.3, Asphalt Saturated Organic Roofing Felt.

.3 CSA A123.4, Asphalt for Constructing Built-Up Roof Coverings and Waterproofing Systems.

.4 CSA A231.1/A231.2, Precast Concrete Paving Slabs/Precast Concrete Pavers.

.5 CSA O121, Douglas Fir Plywood.

.6 CSA O151, Canadian Softwood Plywood.

.3 The Workplace Health and Safety Act (Manitoba), Workplace Health and Safety Regulation:

.1 Safety Data Sheets (SDS).

.4 Underwriters' Laboratories of Canada (ULC):

.1 CAN/ULC-S701.1, Standard for Thermal Insulation, Polystyrene, Boards.

.2 CAN/ULC-S702.1, Standard for Mineral Fibre Thermal Insulation for Buildings, Part 1: Material Specification.

.3 CAN/ULC-S702.2, Standard for Mineral Fibre Thermal Insulation for Buildings, Part 2: Installation.

.4 CAN/ULC-S704.1, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced.

.5 CAN/ULC-S706.1, Standard for Wood Fibre Insulating Boards for Buildings.

1.2 Administrative Requirements

.1 Convene pre-installation meeting three (3) to four (4) weeks prior to beginning waterproofing Work, with roofing contractor's representative and Contract Administrator.

.1 Verify project requirements.

.2 Review installation and substrate conditions.

.3 Co-ordination with other building subtrades.

.4 Review installation instructions and warranty requirements.

1.3 Action and Informational Submittals

.1 Provide submittals in accordance with City of Winnipeg Standard Construction Specification, CW 1110.

.2 Product Data:

.1 Provide two (2) copies of most recent technical roofing components data sheets describing materials' physical properties and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Provide Shop Drawings:

.1 Indicate flashing details.

.2 Provide layout for tapered insulation.

.4 Manufacturer's Certificate: certify that products meet or exceed specified requirements.

.5 Test and Evaluation Reports: submit laboratory test reports certifying compliance of bitumens and roofing felts and membrane with specification requirements.

.6 Manufacturer's Installation Instructions: indicate special precautions required for seaming the membrane.

1.4 Quality Assurance

.1 Installer qualifications: company or person specializing in application of modified bituminous roofing systems with five (5) years documented experience approved by manufacturer.

1.5 Fire Protection

.1 Fire Extinguishers:

.1 Maintain one cartridge operated type or stored pressure rechargeable type with hose and shut-off nozzle,

.2 ULC labelled for A, B and C class protection.

.3 Size 9 kg on roof per torch applicator, within 6 m of torch applicator.

.2 Maintain fire watch for one (1) hour after each day's roofing operations cease.

1.6 Delivery, Storage, and Handling

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

.2 Storage and Handling Requirements:

.1 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of asphalt, sealing compounds, primers and caulking materials.

.2 Provide and maintain dry, off-ground weatherproof storage.

.3 Store rolls of felt and membrane in upright position. Store membrane rolls with salvage edge up.

.4 Remove only in quantities required for same day use.

.5 Place plywood runways over completed Work to enable movement of material and other traffic.

.6 Store sealants at +5°C minimum.

.7 Store insulation protected from daylight and weather and deleterious materials.

1.7 Site Conditions

.1 Ambient Conditions:

.1 Do not install roofing when temperature remains below -18°C for torch application, or -5°C to manufacturers' recommendations for mop application.

.2 Minimum temperature for solvent-based adhesive is -5°C.

.2 Install roofing on dry deck, free of snow and ice, use only dry materials and apply only during weather that will not introduce moisture into roofing system.

.3 Deck shall be high pressure sand blasted prior to installation if material is going on an existing surface.

1.8 Warranty

.1 For Work of this Section 07 52 00 - Modified Bituminous Membrane Roofing, twelve (12) months warranty period is extended to twenty-four (24) months except as stipulated in CW Supplemental Conditions D21.

2. PRODUCTS

2.1 Performance Criteria

.1 Compatibility between components of roofing system is essential. Provide written declaration to Contract Administrator stating that materials and components, as assembled in system, meet this requirement.

.2 Roofing System: to CSA A123.21 for wind uplift resistance.

2.2 Deck Covering

.1 Glass Mat, Gypsum Board: to ASTM C 1177 12.7 mm thick.

2.3 Deck Primer

.1 Asphalt primer: to manufacturer's recommendations.

2.4 Vapour Retarder

.1 Base sheet vapour retarder: Styrene-Butadiene-Styrene (SBS) elastomeric polymer glass reinforcement, weighing 180 g/m².

2.5 Membrane

.1 Base sheet:

.1 Styrene-Butadiene-Styrene (SBS) elastomeric polymer prefabricated sheet, glass reinforcement, having nominal weight of 180g/m².

.2 Type 2.

.3 Class C - plain surfaced.

.4 Grade heavy duty service.

.5 Top and bottom surfaces:

.1 sanded/polyethylene.

.6 Base sheet membrane properties:

.1 Strain energy (longitudinal/transversal): 8.1/8.8 kN/m.

.2 Breaking strength (longitudinal/transversal): 17.0/12.5 N/5 cm.

.3 Ultimate elongation (longitudinal/transversal): 60/65%.

.4 Tear resistance: 60 N.

.5 Cold bending at -30°C: no cracking.

.6 Softening point: 110°C.

.7 Static puncture resistance: > 300.

.8 Dimensional Stability: -0.3/0.3%.

.2 Cap sheet membrane:

.1 Styrene-Butadiene-Styrene(SBS) elastomeric polymer, prefabricated sheet, glass reinforcement, having nominal weight of 250 g/m².

.2 Type 2.

.3 Class A-granule surfaced.

.1 Colour for granular surface: gray.

.4 Grade heavy duty service.

.5 Bottom surface polyethylene.

.6 Cap sheet membrane properties:

.1 Strain energy (longitudinal/transversal): 11.0/11.4 kN/m.

.2 Breaking strength (longitudinal/transversal): 25.0/16.0 kN/m.

.3 Ultimate elongation (longitudinal/transversal): 60/65%.

.4 Tear resistance: 80 N.

.5 Cold bending at -30°C: No cracking.

.6 Softening point: ò 110°C.

.7 Static puncture resistance: > 370.

.8 Dimensional Stability: -0.2/0.2%.

2.6 Adhesive

.1 Adhesive for securing overlay board and insulation: asphalt extended vulcanized adhesive, two component unit, consisting of two liquids mixed on site to produce pourable adhesive.

2.7 Overlay Board

.1 Overlay Board: 12.7 mm to ASTM C 1177M.

.2 Install over insulation to provide torch safe surface.

2.8 Bitumen

.1 Asphalt: to CAN/CSA-A123.4, Type 2.

2.9 Polystyrene Insulation

.1 Extruded polystyrene (XPS) insulation to CAN/ULC-S701.1, Type 4, thickness as indicated, ship lapped edges.

2.10 Sealers

.1 Plastic cement: asphalt.

.2 Sealing compound: rubber asphalt type.

2.11 Carpentry

.1 Refer to Section 06 10 00 - Rough Carpentry.

2.12 Fasteners

.1 Insulation to deck: coated insulation fasteners and galvanized plates must meet FM Approval for wind uplift and corrosion resistance, as recommended by insulation manufacturer.

2.13 Filter Fabric

.1 UV resistant, black woven water pervious polyolefin fabric for installation between insulation and stone ballast in protected membrane system. Fabric to meet approval of insulation manufacturer.

.2 Product weight 77.9 gm/m^2.

3. EXECUTION

3.1 Quality of Work

.1 Do examination, preparation and roofing Work in accordance with Roofing Manufacturer's Specification Manual and CRCA Roofing Specification Manual, particularly for fire safety precautions. Do priming in accordance with manufacturers written recommendations.

.2 The interface of the walls and roof assemblies will be fitted with durable rigid material plywood providing connection point for continuity of air barrier.

.3 Assembly, component and material connections will be made in consideration of appropriate design loads.

3.2 Examination of Roof Decks

.1 Verification of Conditions:

.1 Inspect with Contract Administrator deck conditions including parapets, construction joints, roof drains, plumbing vents and ventilation outlets to determine readiness to proceed.

.2 Prior to beginning of work ensure:

.1 Review deck conditions with contract administrator. Curbs have been built.

.2 Roof drains have been installed at proper elevations relative to finished roof surface.

.3 Plywood and lumber nailer plates have been installed to deck, walls and parapets as indicated.

.3 Do not install roofing materials during rain or snowfall.

3.3 Protection of In-Place Conditions

.1 Cover walls, walks, slopped roofs and adjacent work where materials hoisted or used.

.2 Use warning signs and barriers. Maintain in good order until completion of Work.

.3 Clean off drips and smears of bituminous material immediately.

.4 Dispose of rain water off roof and away from face of building until roof drains or hoppers installed and connected.

.5 Protect roof from traffic and damage. Comply with precautions deemed necessary by Contract Administrator.

.6 At end of each day's work or when stoppage occurs due to inclement weather, provide protection for completed Work and materials out of storage.

.7 Metal connectors and decking will be treated with rust proofing or galvanization.

3.4 Priming Deck

.1 Apply deck primer to concrete roofing substrate at the rate recommended by manufacturer.

3.5 Vapour Retarder (Concrete Deck)

.1 Embed two ply of felts glass in hot bitumen spread at rate of 1.2 kg/m² for glass asphalt.

.2 Modified bituminous vapour retarder sheet.

3.6 (Exposed) Conventional Membrane Roofing (CMR) Application

.1 Fully adhered, adhesive application:

.1 Adhere insulation to laminated vapour barrier using solvent-based adhesive.

.2 Place boards in parallel rows with ends staggered, and in firm contact with one another.

.3 Cut end pieces to suit.

.4 Apply adhesive in continuous ribbons at 300 mm on centre.

.5 Separate the membrane and insulation with a drainage layer or slip-sheet.

.2 Tapered insulation application:

.1 Mop insulation to vapour retarder and top layer of insulation to bottom layer with hot asphalt at rate of 1 kg/m².

.2 Install tapered insulation as second insulation layer, in accordance with shop drawings. Stagger joints between layers 150 mm minimum.

.3 Overlay Board: adhesive application:

.1 Adhere overlay board to insulation with vulcanized adhesive at the rate of 1 L/m².

.2 Place boards in parallel rows with end joints staggered. Cap joints approximately 25 mm.

.3 Cut ends to suit and apply adhesive in continuous ribbons at 300 mm on centre.

.4 Base sheet application:

.1 Starting at low point of roof, perpendicular to slope, unroll base sheet, align and reroll from both ends.

.2 Unroll and torch base sheet onto substrate taking care not to burn membrane or its reinforcement or substrate.

.3 Lap sheets 75 mm minimum for side and 150 mm minimum for end laps.

.4 Application to be free of blisters, wrinkles and fish mouths.

.5 Cap sheet application:

.1 Starting at low point on roof, perpendicular to slope, unroll cap sheet, align and reroll from both ends.

.2 Unroll and torch cap sheet onto base sheet taking care not to burn membrane or its reinforcement.

.3 Lap sheets 75 mm minimum for side laps and 150 mm minimum for end laps. Offset joints in cap sheet 300 mm minimum from those in base sheet.

.4 Application to be free of blisters, fish mouths and wrinkles.

.5 Do membrane application in accordance with manufacturer's recommendations.

.6 Flashings:

.1 Complete installation of flashing base sheet stripping prior to installing membrane cap sheet.

.2 Torch base and cap sheet onto substrate in 1 m wide strips.

.3 Lap flashing base sheet to membrane base sheet minimum 150 mm and seal by mopping or torch welding.

.4 Lap flashing cap sheet to membrane cap sheet 250 mm minimum and torch weld.

.5 Provide 75 mm minimum side lap and seal.

.6 Properly secure flashings to their support, without sags, blisters, fish mouths or wrinkles.

.7 Do work in accordance with Section 07 62 00 - Sheet Metal Flashing and Trim.

.7 Roof penetrations:

.1 Install roof drain pans, vent stack covers and other roof penetration flashings and seal to membrane in accordance with manufacturer's recommendations and details.

3.7 Field Quality Control

.1 Inspection agency must be fully experienced with membrane and installation procedures.

.2 Inspection and testing of roofing application will be carried out by testing laboratory designated by Contract Administrator. Costs of tests will be paid under cash allowance of $5000.

3.8 Cleaning

.1 Remove bituminous markings from finished surfaces.

.2 In areas where finished surfaces are soiled caused by work of this Section, consult manufacturer of surfaces for cleaning advice and complying with their documented instructions.

.3 Repair or replace defaced or disfigured finishes caused by Work of this Section.

END OF SECTION

SHEET METAL FLASHING AND TRIM

1. GENERAL

1.1 Qualifications

.1 Only competent and qualified tradesmen shall execute the Work of this Section, using adequate facilities and equipment.

1.2 Shop Drawings

.1 Submit Shop Drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Clearly indicate materials, thicknesses, finishes, profiles, details, anchor and fastener details, compliance with design criteria, and requirements of related work.

1.3 Design Criteria

.1 Design metal flashings and trim to allow for thermal movement of components caused by ambient temperature range of 80°C without causing buckling, failure to joint seals, undue stress on fasteners or other detrimental effects.

1.4 Warranty

.1 Construction Contractor hereby warrants that the sheet metal flashings and trim will remain watertight for two (2) years. The warranty shall commence on the date of issuance of the Final Certificate of Completion.

1.5 Protection

.1 Protect prefinished steel during fabrication, transportation, site storage, and erection in accordance with CSSBI Standards.

2. PRODUCTS

2.1 Flashings and Trim

.1 Parapet Flashing: minimum 0.45 mm (26 ga) base metal thickness; continuously hot dipped galvanized coated conforming to ASTM A653M with factory pre-finished paint.

.2 Sill Block Drip Flashing: minimum 0.45 mm (26 ga) base metal thickness; continuously hot dipped galvanized coated conforming to ASTM A653M with factory pre-finished paint.

.3 Veneer Ledge Drip Flashing: minimum 0.45 mm (26 ga) base metal thickness; continuously hot dipped galvanized coated conforming to ASTM A653M with factory pre-finished paint.

.4 Locking Strip: same material, thickness and finish as flashings.

2.2 Accessories

.1 Isolation Coating: to MPI (Master Paint Institute) EXT 5.5D.

.2 Fasteners: of same material as sheet metal, flat head roofing nails of lengths and thickness suitable for metal flashing application. Colour of head to match finish of flashing.

2.3 Fabrication

.1 Fabricate metal flashings and other sheet metal work as detailed on Drawings.

.2 Form pieces in 3000 mm maximum lengths. Make allowance for expansion at joints.

.3 Hem exposed edges on underside 12 mm. Miter and seal corners with sealant.

.4 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

.5 Apply isolation coating to metal surfaces to be secured to concrete and pressure treated lumber.

3. EXECUTION

3.1 Installation

.1 Form and install flashings as detailed or as required.

.2 Use exposed fasteners.

.3 Joints shall be common (clinch) lock, hook seam type and allowing for expansion and contraction. Corners shall be square and surface shall be straight and in true planes and free from oil-canning or other defects.

.4 Install continuous metal drips, cleats, clips and starter strips as shown or required to hold flashings in true planes without deformation.

.5 Apply isolation coating to metal surfaces to be secured to concrete and pressure treated lumber.

.6 Lock end joints and seal with sealant. Reference Section 07 92 00 - Joint Sealants for material and installation requirements.

END OF SECTION

ROOF HATCHES

1. GENERAL

1.1 Summary

.1 Work Included: Provide factory-fabricated roof hatches for access.

1.2 Design and Performance Criteria

.1 Cover shall be reinforced to support a minimum live load of 40 psf (195 kg/m^2) with a maximum deflection of 1/150th of the span or 20 psf (97 kg/m^2) wind uplift.

.2 Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.

.3 Operation of the cover shall not be affected by temperature.

.4 Entire hatch shall be weathertight with fully welded corner joints on cover and curb.

1.3 Submittals

.1 Submit Shop Drawings in accordance with Section 01 33 00.

.2 Clearly indicate and describe all items of this section fully and accurately detailed.

.3 Include size and description of components, materials, thicknesses and finish, anchorage devices, construction details and dimensions, hardware and all other pertinent information.

.4 Submit manufacturer's installation instructions.

.5 Provide maintenance data for hardware complete with pertinent details, spare parts lists and warning against harmful maintenance materials and practices for incorporation into O & M Manual.

.6 Warranty: Submit executed copy of manufacturer's standard warranty.

1.4 Quality Assurance

.1 Manufacturer: A minimum of five (5) years' experience manufacturing similar products.

.2 Installer: A minimum of two (2) years' experience installing similar products.

.3 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.5 Warranty

.1 Provide the City with manufacturer's guarantee covering proper operation and corrections of failures in material and workmanship of the products.

.2 Guarantee period shall be for five (5) years and shall commence on the date of issuance of Certificate of Substantial Performance.

2. PRODUCTS

2.1 Manufacturer

.1 Basis-of-Design: Roof Hatches by Bilco Company.

2.2 Roof Hatch

.1 Furnish and install where indicated on plans metal roof hatches. The roof hatch shall be double leaf and shall be pre-assembled from the manufacturer.

.1 Hatches to Reservoir: H100. Type D, size: (1220 mm x 1220 mm).

.2 Performance characteristics:

.1 Cover and curb shall be thermally broken to prevent heat transfer between interior and exterior surfaces.

.2 Cover shall be reinforced to support a minimum live load of 40 psf (195 kg/m^2) with a maximum deflection of 1/150th of the span or 20 psf (97 kg/m^2) wind uplift.

.3 Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.

.4 Operation of the cover shall not be affected by temperature.

.5 Entire hatch shall be weather tight with fully welded corner joints on cover and curb.

.3 Cover: Shall be 2.3 mm (11 gauge) aluminium with a 76 mm (3”) beaded flange with formed reinforcing members. Interior and exterior surfaces shall be thermally broken to minimize heat transfer and to resist condensation. Cover shall have a heavy extruded EPDM rubber gasket bonded to the cover interior to assure a continuous seal when compressed to the top surface of the curb.

.4 Cover insulation: Shall be 3” (75mm) thick polyisocyanurate with an R-value = 20.3 (U=0.279 W/m^2K), fully covered and protected by a 1 mm (18 gauge) aluminium liner.

.5 Curb: Shall be 305 mm (12”) in height and of 2.3 mm (11 gauge) aluminium. Interior and exterior surfaces shall be thermally broken to minimize heat transfer and to resist condensation. The curb shall be formed with a 140 mm (5-1/2”) flange with 11 mm (7/16”) holes provided for securing to the roof deck. The curb shall be equipped with an integral metal capflashing of the same gauge and material as the curb, fully welded at the corners, that features the Bil-Clip® flashing system, including stamped tabs, 153 mm (6”) on centre, to be bent inward to hold single ply roofing membrane securely in place.

.6 Curb insulation: Shall be 3” (75mm) thick polyisocyanurate with an R-value = 20.3 (U=0.279 W/m^2K).

.7 Lifting mechanisms: Manufacturer shall provide compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and closing. The upper tube shall be the outer tube to prevent accumulation of

moisture, grit, and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe welded to the curb assembly.

.8 Hardware:

.1 Heavy stainless steel pintle hinges shall be provided.

.2 Cover shall be equipped with a spring latch with interior and exterior turn handles.

.3 Roof hatch shall be equipped with interior and exterior padlock hasps.

.4 The latch strike shall be a stamped component bolted to the curb assembly.

.5 Cover shall automatically lock in the open position with a rigid hold open arm equipped with a 1" (25mm) diameter red vinyl grip handle to permit easy release for closing.

.6 Compression spring tubes shall be an anti-corrosive composite material and all other hardware shall be Type 316 stainless steel.

.7 Cover hardware shall be bolted into heavy gauge channel reinforcing welded to the underside of the cover and concealed within the insulation space.

.8 Finishes: Factory finish shall be mill finish aluminium.

3. EXECUTION

3.1 Examination

.1 Examine substrates and openings for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Installation

.1 Install products in strict accordance with manufacturer's instructions and approved submittals. Locate units level, plumb, and in proper alignment with adjacent work.

.1 Test units for proper function and adjust until proper operation is achieved.

.2 Repair finishes damaged during installation.

.3 Restore finishes so no evidence remains of corrective work.

3.3 Adjusting and Cleaning

.1 Clean exposed surfaces using methods acceptable to the manufacturer which will not damage finish.

END OF SECTION

FIRESTOPPING

1. GENERAL

1.1 Quality Assurance

.1 Firestopping and smoke sealing shall be by competent installers having minimum five (5) years experience in application of materials and systems being used, approved and trained by material or system manufacturer.

1.2 Submittals

.1 Submit Shop Drawings and samples in accordance with Section 01 33 00 - Submittal Procedures.

.2 Shop Drawings to indicate ULC assembly number for each condition, required temperature rise and flame rating, hose stream rating, thickness, installation methods and materials of firestopping and smoke seals, damming materials, reinforcements, anchorages and fastenings, size of opening, adjacent materials and number of penetrations. Submit copies of current ULC listings for each system and certified copies of test reports verifying that firestopping and smoke seals meet or exceed specified requirements.

1.3 Environmental Requirements

.1 Comply with requirements of WHMIS regarding use, handling, storage, and disposal of hazardous materials; and material safety data sheets acceptable to Ministry of Labour.

2. PRODUCTS

2.1 Materials

.1 Certified and listed by ULC or WH in accordance with CAN/ULC4 – S115 and bearing ULC or WH label, products shall be heat resistant, flexible, durable and compatible with adjacent materials and finishes. System shall be self-supporting at penetration capable to adhere and yet maintain its integrity while providing effective barrier against passage of flame, smoke and gases. Product shall provide flame and temperature rating in accordance with requirements of National Building Code of Canada 2010 and Manitoba Amendments for openings in respective fire resistance wall or other assembly.

.2 Asbestos free firestopping and smoke seal materials and/or systems to provide closures to fire and smoke at openings around penetrations, and at openings and joints within fire separations and assemblies having a fire-resistance rating, including openings and spaces at perimeter edge conditions. System shall provide draft tight barriers to retard passage of flame and smoke, and firefighter's hose stream and passage of liquids. Provide firestopping and smoke seals within mechanical (i.e. inside ducts, dampers) and electrical assemblies (i.e. inside bus ducts) respectively and around outside of such mechanical and electrical assemblies where they penetrate rated fire separations.

.3 Firestop Systems: Certified by ULC, WH and listed in ULC Guide No. 40 U19.

.4 Firestop System Components: Certified by ULC, WH and listed in ULC Guide No. 40 U19.13 under the Label Service of ULC.

.5 Cementitious Matrices: Minimum 2758 kPa (400 psi) compressive strength when cured, to retard cable tray warping within the firestop seal.

.6 Firestopping and Smoke Seals at openings where reinstallation occurs: An elastomeric or re-useable cementitious matrix or putty seal; do not use a permanent cementitious seal at such locations.

.1 Firestopping and smoke seals at openings around penetrations for electrical bus ducts, pipes, ductwork and other electrical and mechanical items requiring sound and vibration control or allowance for expansion, contraction and other movement: An elastomeric seal; do not use a cementitious or rigid seal at such locations.

.2 Firestopping and smoke seals at joints and spaces designed and required to allow movement such as building movement joints, deflection spaces, control joints, expansion joints, and similar locations shall be flexible, elastomeric seal suitable to withstand the required movement and capable of returning to original configuration without damage to seal and without adhesive or cohesive failure; do not use a cementitious or rigid seal at such locations.

.3 Primers: To manufacturer's recommendation for specific material, substrate, and end use.

.4 Water (if applicable): Potable, clean and free from injurious amounts of deleterious substances.

.5 Damming and Back-up Materials, Supports and Anchoring Devices: To manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to Authorities Having Jurisdiction.

.6 Pipe and Duct Insulation and Wrappings: Compatible with firestopping systems.

.7 Intumescent Pads: Permanently pliable type.

.8 Intumescent Composite Sheet: Composite sheet, strip or precut shapes.

.9 Sealants and Putty for Vertical and Overhead Joints: Non-sagging.

.10 Materials and products shall not cause stress, chemical or physical reaction, or other damage to penetrating items or adjacent materials.

3. EXECUTION

3.1 Installation

.1 Ensure materials and products are compatible with abutting materials, coatings and finishes. Remove applied coatings and finishes as required to permit proper installation and adhesion.

.2 Ensure that pipe and duct insulation and wrappings occurring within openings to receive firestopping and smoke seal are installed prior to work of this Section and that insulation and wrapping within fire seals is a ULC listed component of the system to be installed, unless ULC certified assembly permits such other insulation and wrapping to remain within the assembly. Otherwise, precede installation of mechanical insulations or remove insulation

from area of insulated pipe or duct where such pipes or ducts penetrate a fire separation. Ensure the continuity and integrity of thermal and vapour barriers where such are removed, altered, or replaced, acceptable to the Contract Administrator.

.3 Apply firestopping and smoke seals in accordance with manufacturer's instructions and tested designs acceptable to authorities having jurisdiction to provide required temperature and flame rated seal, and to prevent passage of smoke and liquids.

.4 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing. Completely fill and seal voids with firestopping and smoke seal materials. Do not cover up materials until full curing has taken place. Notify when completed installations are ready for inspection and prior to concealing or enclosing firestopping and smoke seals.

3.2 Cleaning

.1 Remove excess materials and debris and clean adjacent surfaces immediately after application. Remove temporary dams after initial set of firestopping and smoke seal materials.

END OF SECTION

JOINT SEALANTS

1. GENERAL

1.1 Work Included

.1 Supply and install of all sealant and backing materials as required and not listed under Section 03 15 00 - Concrete Accessories.

.2 Specialty Sealant between concrete masonry units and Pre-Engineered Building components.

1.2 Quality Assurance and Regulatory Requirements

.1 Installation of sealant work shall be carried out by a recognized specialized applicator having skilled mechanics, thoroughly trained and competent in all phases of sealant work, with at least five (5) years experience.

1.3 Environmental Conditions

.1 Sealant and substrate materials to be minimum 5°C.

.2 Should it become necessary to apply sealants below 5°C, consult sealant manufacturer, provide official letter from the manufacturer, and follow their recommendations.

1.4 Submittals

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

.2 Submit sealant colour samples.

.3 Submit two (2) samples of the interior specialty sealant complete with manufacturer's written installation instructions.

1.5 Maintenance Data

.1 Provide operation and maintenance data for each sealant and caulking for incorporation into maintenance manual specified in Section 01 78 00 - Closeout Submittals.

2. PRODUCTS

2.1 Materials

.1 Primers: type recommended by sealant manufacturer.

.2 Joint Fillers:

.1 General: compatible with primers and sealants, outsized 30 to 50%.

.2 Polyethylene, urethane, neoprene or vinyl: extruded closed cell foam, Shore A hardness 20, tensile strength 140 to 200 kPa.

.3 Bond Beaker: pressure sensitive plastic tape, which will not bond to sealants.

.4 Joint Cleaner: non-corrosive type recommended by sealant manufacturer and compatible with sealant.

.5 Sealants – Exterior:

.1 Dow Corning 790 Silicone Building Sealant, colours to be selected by the Contract Administrator to match substrate colour. Colours are to be chosen from the manufacture's standard colours.

.6 Sealants – Interior concrete block control joints:

.1 Dow Corning 790 Silicone Building Sealant, colours to be selected by the Contract Administrator to match substrate colour. Colours are to be chosen from the manufacture's standard colours.

.7 Sealants – Interior Wet and Damp Areas above Main Floor Elevation:

.1 DAP KWIK SEAL PLUS Premium Kitchen & Bath Adhesive Caulk w/MICROBAN.

.8 Sealants – Interior Dry Areas above Main Floor Elevation (non fire rated):

.1 DAP Alex Plus Acrylic Latex Caulk Plus Silicone (paintable).

.9 Interior Specialty Sealant between concrete masonry units and Pre-Engineered Building components: Interior Specialty Sealant: Seismic Colorseal by Emseal Corporation.

.10 Cleaning material for surfaces to receive sealant as recommended by the Manufacturer of sealant.

3. EXECUTION

3.1 Preparation

.1 Remove dust, paint, loose mortar and other foreign matter. Dry joint surfaces.

.2 Remove rust, mill scale and coatings from ferrous metals by wire brush, grinding or sandblasting.

.3 Remove oil, grease, and other coatings from nonferrous metals with joint cleaner.

.4 Prepare concrete, glazed, and vitreous surfaces to sealant manufacturer's instructions.

.5 Examine sealant joint sizes and correct to achieve depth ratio 1/2 of joint width with minimum width and depth of 6 mm, maximum width 25 mm.

.6 Examine interior specialty sealant joint sizes to achieve minimum clearances as indicated. Coordinate clearances Pre-Engineered Structure building component deflections.

.7 Install interior specialty sealant material and related sealant in accordance with specialty sealant manufacturer's written instructions.

.8 Install joint filler to achieve correct joint depth.

.9 Where necessary to prevent staining, mask adjacent surfaces prior to priming and sealant.

.10 Apply bond breaker tape where required to manufacturer's instructions.

.11 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to application of sealant.

.12 Specialty sealant:

.1 Coordinate space requirements and solid backing locations for support of the specialty sealant.

.2 Remove all materials, waxes, wax compounds, grease, grease compounds, asphalt and asphalt compounds that would cause delamination of the specialty sealant.

3.2 Application

.1 Apply sealants, primers, joint fillers, bond breakers, to manufacturer's instructions. Apply sealant using gun with proper size nozzle. Use sufficient pressure to fill voids and joints solid. Superficial pointing with skin bead is not acceptable.

.2 Apply sealant to joints between access frames to adjacent building components, around perimeter of every external opening, to control joints in concrete slabs.

.3 Hand tool all sealant.

.4 Specialty sealant:

.1 Seal precompressed specialty sealant sides to substrate with specialty sealant manufacturer's specific silicone sealant.

.2 Butter and seal precompressed ends of specialty sealant to substrate and adjoining ends of multiple sections of specialty sealant.

3.3 Warranty

.1 Provide a three (3) year warranty against delamination of the sealant. Warranty will include coverage of installed sealants and accessories which fail to achieve air tight and watertight seal, exhibit loss of adhesion or cohesion, or do not cure. Warranty period starts on the date of the Final Certificate of Completion.

END OF SECTION

METAL DOORS AND FRAMES

1. GENERAL

1.1 Design Requirements

.1 Design exterior frame assembly to accommodate expansion and contraction when subjected to surface temperature range of minus 40°C to 35°C.

.2 Install Work to CSDMA (Canadian Steel Door Manufacturers' Association) Installation Guide.

1.2 Related Sections

.1 Section 08 71 00 – Door Hardware: Product Requirements for cylinder core and keys.

.2 Section 09 91 00 – Painting: Field applied finish.

1.3 Quality Assurance

.1 Source Limitations: Obtain doors and frames through one source from a single manufacturer.

1.4 Submittals

.1 Submit Shop Drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Indicate each type of door and frame, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, arrangement of hardware and fire rating.

.3 Include schedule identifying each unit, with door marks and numbers relating to the numbering on the Drawings.

1.5 Maintenance Data

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

1.6 Delivery, Storage and Handling

.1 Brace and protect doors and frames to prevent distortion during shipment. Store in a secure dry location.

.2 Store doors vertically, resting on planks, with blocking between to allow air to circulate.

2. PRODUCTS

2.1 Materials

.1 Metallic Coated Sheet Steel: ASTM A568M Class 1 Commercial grade steel, hot dip galvanized to ASTM A 653/A653M Z275 zinc coated (Galvanized).

.2 Minimum Core Thickness, Without Coating: Metallic Coated Sheet Steel:

.1 Interior Door Frames, welded type: 1.51 mm (16 gauge).

.2 Exterior Door Frames, welded type, Thermally Broken: 2.0 mm (14 gauge).

.3 Interior Doors:

.1 Welded stiffener construction.

.2 Face Sheets: 1.21 mm (18 gauge).

.3 Vertical Stiffeners: 0.912 mm (20 gauge).

.4 Infill voids with batt insulation.

.4 Exterior doors:

.1 Welded stiffener construction.

.2 Face sheets: 2.0 mm (14 gauge).

.3 Vertical Stiffeners, 1.21 mm (18 gauge).

.4 Infill voids with batt insulation.

.5 Fire-rated frames and corresponding doors shall be provided for those openings requiring fire protection and temperature rise ratings, as determined and scheduled by the Contract Administrator. Such products shall be listed in conformance with CAN4/ULC-S104, CAN4/ULC-S105M. All fire-rated assembles shall bear the label of, and be listed by ULC, cUL or Warnock-Hersey International Ltd., labels. Labelling shall be in accordance with NFPA 80, the listing authority's policies and label materials and shall identify the manufacturer. Fire-rated doors shall be constructed as listed for labelling in the Follow-Up Service Procedures/Factory Inspection Manuals issued by the listing agency to individual manufacturers.

.1 Smoke Door: shall be fire rated as indicated above and shall include smoke door assembly gasketing in accordance with NFPA 105.

.2 Fire rated interior window frame constructed similar to above fire rated welded frames.

.6 Lock and Strike Reinforcements: 1.51 mm (16 gauge).

.7 Hinge and Pivot Reinforcements: 2.66 mm thick by minimum 38 mm wide x minimum 150 mm longer than hinge and pivot, secured by not less than 6 spot welds.

.8 Reinforcements for Closer, Holder and other surface applied hardware: 1.21 mm (18 gauge).

.9 Top and Bottom End Channels: and Caps: 1.21 mm (18 gauge).

.10 Steel top caps: 0.91 mm (20 gauge).

.11 Mortar Guard Boxes: 0.759 mm (22 gauge).

.12 Floor Anchors: 1.51 mm (16 gauge).

.13 Jamb Spreaders: 0.91 mm (20 gauge).

.3 Frame Anchors:

.1 Fixed ‘Z’ shape to suit installation to steel sub-girt and steel column.

.2 Adjustable masonry ‘T’ style anchor to suit installation to masonry wall.

.4 Adhesives for Steel Components: Heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.

.5 Touch-up galvanizing with minimum two (2) coats of zinc-rich primer.

.6 Door Silencers: Single stud rubber or neoprene.

.7 Filler: Metallic paste, manufacturer's standard.

.8 Thermal Break: Rigid PVC extrusion.

.9 Exterior Door Frame Insulation: closed-cell foam with water-resistant outer skin when cured, Great Stuff as manufactured by Dow Chemical unless otherwise required to maintain specified fire and smoke rating.

2.2 Fabrication – General

.1 Fabricate Work in accordance with CSDMA specifications.

.2 Blank, reinforce, drill and tap units for mortised, templated hardware, and electronic hardware using templates provided by the hardware suppliers. Reinforce units for surface mounted hardware.

.3 Do welding to CSA W59, Welded Steel Construction.

.4 Apply, at factory, touch-up primer to doors and frames where coating has been removed during fabrication.

.5 Make provisions in doors and frames to suit requirements of Section providing security devices.

2.3 Fabrication – Frames

.1 Fabricate frames to profiles and maximum face sizes as required to suit design, and are to be of welded construction.

.2 Punch or saw-mitered at the Manufacturer’s discretion. All profile welded frame product exposed faces shall be filled and ground to a smooth, uniform seamless surface.

.3 Protect mortised cut-outs with mortar guard boxes in masonry. Conceal fastenings except where exposed fastenings are required. Supply and Install appropriate anchorage to floor and wall construction.

.4 Supply and install jamb anchors for fixing at floor.

.5 Supply and install three (3) door silencers on strike jamb for each single door, and two (2) bumpers at head of frame for each door leaf in double doors.

.6 Fabricate thermally broken frames for exterior doors using steel core, separating exterior portion of frame from interior portion with PVC thermal breaks.

2.4 Fabrication – Doors

.1 Longitudinal edges shall be tack welded at top and bottom of door, above and below each edge cut out and at 150 mm on centre, filled and sanded flush.

.2 Vertical steel stiffeners shall be securely welded to each face sheet at 150 mm on centre maximum.

.3 Provide top and bottom of doors with inverted, recessed, welded steel channels.

.4 Provide exterior doors with flush PVC top caps.

3. EXECUTION

3.1 Installation – General

.1 Install Work to CSDMA (Canadian Steel Door Manufacturers Association) Guide Specification for Installation and Storage of Hollow Metal Doors and Frames.

.2 Install fire rated with smoke door assemblies in accordance with NFPA 80 and NFPA 105 and with the terms of their listings.

.3 Touch-up with primer galvanized finish damaged during installation.

.4 Apply touch-up primer to doors and frames where coating has been damaged.

3.2 Installation – Frames

.1 Set frames plumb, square, level and at correct elevation.

.2 Secure anchorages and connections to adjacent construction.

.3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings exceeding 1200 mm in width.

.4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.

.5 Apply insulation to fill voids in exterior frame assemblies.

3.3 Installation – Doors

.1 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows:

.1 Hinge side: 3 mm.

.2 Latchside and head: 3 mm.

.3 Finished floor for non-rated assemblies: 12 mm, unless otherwise indicated.

.4 Finished floor for rated assemblies: To NFPA 80 requirements.

.5 Finished floor for smoke rated assemblies: To NFPA 80 and NFPA 105 requirements.

.2 Adjust operable parts for correct function.

3.4 Cleaning

.1 Clean and make good all surfaces soiled or otherwise damaged in connection with work. Upon completion of Work and remove debris, equipment and excess material from Site.

END OF SECTION

COILING DOORS

1. GENERAL

1.1 Section Includes

.1 Rolling steel fire doors.

1.2 Related Sections

.1 Section 08 71 00 - Door Hardware: Product Requirements for cylinder core and keys.

.2 Section 09 91 00 - Painting: Field applied finish.

.3 Section 26 05 25 - Raceway and Boxes: Conduit from electric circuit to door operator and from door operator to control station.

.4 Section 26 27 26 - Wiring Connections: Power to disconnect.

1.3 References

.1 ANSI/DASMA 108 - American National Standards Institute Standard Method For Testing Sectional Garage Doors And Rolling Doors: Determination Of Structural Performance Under Uniform Static Air Pressure Difference.

.2 ANSI/DASMA 203 - American National Standards Institute Specifications for non-rated fire rolling doors published by Door & Access Systems Manufacturers Association International.

.3 ASTM A 123 - Zinc Hot-Dipped Galvanized Coatings on Iron and Steel Products.

.4 ASTM A 229 - Steel Wire, Oil-Tempered for Mechanical Springs.

.5 ASTM A 653 - Steel Sheet, Zinc-Coated Galvanized by the Hot-Dipped Process, Commercial Quality.

.6 ASTM E 330 - Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

.7 ASTM E 413 - Classification for Rating Sound Insulation.

1.4 Submittals

.1 Submit under provisions of Section 01 33 00 – Submittal Procedures.

.2 Product Data: Manufacturer's data sheets on each product to be used, including:

.1 Preparation instructions and recommendations.

.2 Storage and handling requirements and recommendations.

.3 Installation methods.

.3 Shop Drawings: Include detailed plans, elevations, details of framing members, anchoring methods, required clearances, hardware, and accessories. Include relationship with adjacent construction.

.4 Selection Samples: For each finish product specified, two (2) complete sets of color chips representing manufacturer's full range of available colors and patterns.

.5 Verification Samples: For each finish product specified, two (2) samples, minimum size 6 inches (150 mm) long, representing actual product, color, and patterns.

.6 Manufacturer's Certificates: Certify products meet or exceed specified requirements.

.7 Closeout Submittals: Provide manufacturer’s maintenance instructions that include recommendations for periodic checking, adjustment and lubrication of components.

1.5 Quality Assurance

.1 Manufacturer Qualifications: Company specializing in performing Work of this section with a minimum of five (5) years experience in the fabrication and installation of security closures.

.2 Installer Qualifications: Installer Qualifications: Company specializing in performing Work of this section with minimum three (3) years and an authorized Wayne Dalton installer.

1.6 Delivery, Storage and Handling

.1 Store products in manufacturer's unopened packaging with seals and labels intact until ready for installation.

.2 Store materials off the ground in a dry, warm, ventilated weathertight location.

1.7 Sequencing

.1 Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.

.2 Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.8 Project Conditions

.1 Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.9 Warranty

.1 Provide rolling steel service doors and rolling steel fire doors with limited two (2) Year Warranty from Substantial Completion on defects in materials and workmanship on the door; excludes the counterbalance spring and finish.

.2 Provide rolling steel Advanced Performance service doors with limited five (5) Year Warranty from Substantial Completion on all doors system materials and workmanship.

.3 Provide aluminum security shutters, Model 523 with limited two (2) Year Warranty from Substantial Completion on defects in materials and workmanship on the door and components. Provide Powder Coat Finish with a two (2) years warranty against excessive fading, cracking, blistering, flaking or peeling.

2. PRODUCTS

2.1 Manufacturers

.1 Acceptable Manufacturer:

.1 Wayne Dalton
2501 S. State Highway 121 Business, Suite 200,
Lewisville, TX 75067
Phone: (800) 827-3667
Web Site: www.wayne-dalton.com
Email: info@wayne-dalton.com

.2 or approved equal.

.2 Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

2.2 Rolling Steel Fire Doors

.1 Wayne Dalton ThermoTite800C Insulated Rolling Steel Door:

.1 Description:

.1 Maximum Width: Refer to Door Schedule.

.2 Maximum Height: Refer to Door Schedule.

.3 Fire Labeled: No.

.4 Windload: Windload minimum 27 psf per DASMA 108-2012 and as required by local codes.

.2 Curtain: composed of interlocking roll-formed slats.

.1 Slat Profiles/Material:

.1 No. 34 Flat-faced slat. Area between the #34 exterior slat and the back slat filled with polyurethane insulation with providing an R-value of 7.7 (U = 0.13).

.1 18-gauge galvanized steel front and 24- gauge backer.

.2 Ends of alternate slats fitted with metal endlocks/windlocks.

.3 Bottom Bar: Consists of two equal angles, 305 minimum thickness, to stiffen curtain. Angle shall be:

.1 Stainless steel.

.4 Guides:

.1 Three structural angle guide assembly fabricated of:

.1 Stainless steel.

.2 Provide with perimeter brush seals to reduce smoke/air infiltration around door opening.

.5 Brackets: Design to enclose ends of coil and provide support for counterbalance pipe at each end. Fabricate of steel plates, with permanently sealed ball bearings. Thickness shall be:

.1 6 mm minimum.

.6 Counterbalance: Curtain to be coiled on a pipe of sufficient size to carry door load with deflection not to exceed 0.033 inch per foot of door span. Curtain to be correctly balanced by helical springs, oil tempered torsion type. Cast iron barrel plugs will be used to anchor springs to tension shaft and pipe.

.7 Hood: Hood to enclose curtain coil and counterbalance mechanism. Hood fabricated of sheet metal, flanged at top for attachment to header and flanged at bottom to provide longitudinal stiffness. Provide all FM hoods with a steel hood baffle. Fabricate of:

.1 Minimum 24-gauge stainless steel.

.8 Finish: Shop coat of rust inhibitive primer on non-galvanized surfaces and operating mechanisms. Guides and bracket plates will be coated with a flat black prime paint.

.1 Galvanized steel:

.1 Powdercoat finish as selected from manufacturer’s RAL color selections.

.2 Stainless steel finish.

.1 #4 finish.

.9 Operation: Door will be operated by electric motor and complete with the following:

.1 Operator: Jackshaft type, water tight / dust-tight (Nema 4/12).

.2 CSA labelled control station:

.1 Supply power requirements: 208 V, 1ø, 60 Hz.

.2 Reversing contactor: Heavy duty type.

.3 Overload Relay: For protection from over current and under voltage. This relay can be reset manually.

.4 24 V control circuit: For User’s protection.

.5 Door shall be operated by one – three position weatherproof push button station (open-stop-close) located on side adjacent to door.

.3 Automatic Adjustable Friction Clutch: To protect door and operator in case of obstruction.

.4 Limit Switches: Micro switches for automatic stopping of door in up and down positions, easily adjustable without tools.

.5 Sensing edge attached to bottom bar to stop and reverse door when it contacts an object during the closing cycle.

.10 Governor: If required by the size for chain hoist or motor driven doors, provide a viscous governor to regulate the rate of descent of door in a quiet manner. Use an engagement type that is not engaged during normal door operation, but after cable release, will retard the speed during automatic door closure to under 24 inches per second and not less than 6 inches per second per NFPA 80.

.11 Label: Provide rolling fire doors certified with the following listing.

.1 FM 1 1/2-Hour Class B Label when installed on fire-rated masonry walls.

.12 Mounting:

.1 Fire Rated masonry block.

3. EXECUTION

3.1 Examination

.1 Do not begin installation until substrates have been properly prepared.

.2 Examine conditions of substrates, supports, and other conditions under which this Work is to be performed.

.3 If substrate preparation is the responsibility of another installer, notify Contract Administrator of unsatisfactory preparation before proceeding. By proceeding with work, the Contractor accepts the conditions, and any further repairs shall be paid by the Contractor.

3.2 Preparation

.1 Clean surfaces thoroughly prior to installation.

.2 Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 Installation

.1 Install in accordance with manufacturer's instructions.

.2 Install rolling fire doors in accordance with the manufacturer’s instructions and in accordance with the requirements of the National Fire Protection Association Standard 80 (NFPA 80).

.3 Install door complete with necessary hardware, jamb and head mold strips, anchors, inserts, hangers, and equipment supports in accordance with final Shop Drawings, manufacturers instructions, and as specified herein.

.4 Fit, align and adjust rolling door assemblies level and plumb for smooth operation.

.5 Upon completion of final installation, lubricate, test and adjust doors to operate easily, free from warp, twist or distortion and fitting for entire perimeter.

3.4 Testing

.1 Drop-test rolling steel fire doors in accordance with NFPA 80 and witnessed, attesting to their successful operation at the time of installation.

3.5 Maintenance

.1 Per NFPA 80, paragraph 15-2 4.3: All horizontal or vertical sliding and rolling fire doors shall be inspected and tested annually to check for proper operation and full closure. Resetting of the release mechanism shall be done in accordance with the manufacturers instructions. A written record shall be maintained by the building owner and made available to the Authority Having Jurisdiction.

3.6 Adjusting

.1 Test for proper operation and adjust as necessary to provide proper operation without binding or distortion.

.2 Adjust hardware and operating assemblies for smooth and noiseless operation.

3.7 Cleaning

.1 Clean curtain and components using non-abrasive materials and methods recommended by manufacturer.

.2 Remove labels and visible markings.

.3 Touch-up, repair or replace damaged products before Substantial Completion.

3.8 Protection

.1 Protect installed products until completion of project.

.2 Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

ALUMINUM WINDOWS

1. GENERAL

1.1 Reference

.1 CAN/CSA-A440 Windows.

.2 Galvanizing for steel shapes: conforming to ASTM A 123/A 123M.

.3 Galvanizing for steel fasteners: conforming to ASTM A 153/A 153M.

1.2 Shop Drawings

.1 Submit Shop Drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Indicate materials and details in scale full size for head, jamb, sill, and profiles of components, elevations of unit, anchorage details, location of isolation coating, description of related components and exposed finishes, fasteners and sealant. Indicate location of Manufacturer's nameplates.

1.3 Test Reports

.1 Submit test reports from approved independent testing laboratories, certifying compliance with Specifications, for:

.1 Windows.

.2 Anodized finish.

.3 Air tightness.

.4 Water tightness.

.5 Wind load resistance.

.6 Condensation resistance.

1.4 Performance Requirements

.1 Submit test reports from approved independent testing laboratories, certifying compliance with Specifications, for:

.1 Fixed Window:

.1 Air tightness: Fixed.

.2 Water tightness: B7.

.3 Wind load resistance: C5.

.4 Condensation resistance: Temperature Index, I=58 minimum.

.5 Forced entry: F10.

1.5 Maintenance Data

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

2. PRODUCTS

2.1 Materials

.1 Materials: to CAN/CSA-A440 supplemented as follows.

.1 All windows by same Manufacturer.

.2 Exterior Main Frame:

.1 Aluminum thermally broken, head, jambs, sill: Rain Blade 1990 Series Feature Line, Rain Screen Design with 130 mm depth by Alumicor Limited. Extruded aluminum alloy: 6063-T6.

.2 Isolation coating: alkali resistant bituminous paint.

.3 Fasteners: Non-magnetic, stain and corrosion resistant stainless steel.

2.2 Window Type and Classification

.1 Exterior Type:

.1 Fixed: with removable dual glazing insulating glass.

.2 Glazing components to be removable without the use of specialty tools.

2.3 Fabrication

.1 Fabricate in accordance with CAN/CSA-A440 supplemented as follows.

.1 Face dimensions detailed are maximum permissible sizes.

.2 Brace frames to maintain squareness and rigidity during shipment and installation.

.3 Finish clips and reinforcement to frame Manufacturers' written recommendation.

2.4 Aluminum Finishes

.1 Exterior exposed aluminum surfaces: To AAMA 2604, 2-coat, thermal setting enamel consisting of primer and topcoat, 0.03 mm (1.2 mil) minimum total thickness. Colour: custom colour as directed by the Contract Administrator.

.1 Acceptable material; PPG Industries Inc., Duranar.

.2 Interior exposed aluminum surfaces: To AA DAF-45-M12C22A31, Architectural Class II, clear anodized 10 µm (0.0004 inches) minimum thickness.

.1 Acceptable material: Alumicor Ltd., Class II Anodic Finish.

2.5 Isolation Coating

.1 Isolate aluminum from following components, by means of isolation coating:

.1 Dissimilar metals except stainless steel, zinc or white bronze of small area.

.2 Concrete, mortar and masonry.

.3 Wood.

2.6 Foam Insulation

.1 Spray Foam Insulation: closed-cell foam with water-resistant outer skin when cured, Great Stuff as manufactured by Dow Chemical. Low expansion for windows.

3. EXECUTION

3.1 Window Installation

.1 Install in accordance with CAN/CSA-A440.

.2 Window installers to have a minimum two (2) years experience in this type of Work.

.3 Arrange components to prevent abrupt variation in colour.

3.2 Sill Installation

.1 Install metal sills with uniform wash to exterior, level in length, straight in alignment with plumb upstands and faces. Use one piece lengths at punched window locations.

.2 Cut sills to fit window opening.

.3 Secure sills in place with anchoring devices located at end joints of continuous sills and evenly spaced 600 mm on centre in between.

3.3 Foam Installation

.1 Install foam insulation between building elements and window frame. Ensure foam insulation fills void but does not damage window frame components.

3.4 Sealant

.1 Seal joints between windows and window sills with sealant. Bed sill cover plates and drip deflectors in bedding compound. Seal between sill upstand and window-frame.

END OF SECTION

DOOR HARDWARE

1. GENERAL

1.1 Quality Assurance

.1 Furnish services of a Door and Hardware Institute Certified Consultant for preparation of hardware Shop Drawings, keying, coordination with other Sections, consultation with the Contract Administrator for on-site reviews.

.2 Inspect all hardware after installation by the manufacturer's representative who shall certify in writing to the City, that all hardware has been supplied and installed in accordance with the Specifications and reviewed Shop Drawings, and are functioning properly.

.3 Hardware for doors in fire separations and exit doors certified by a Canadian Certification Organization accredited by Standards Council of Canada.

.4 Provide to applicable Sections templates and information required for proper preparation and application of hardware in ample time to facilitate progress of Work.

.5 Before supplying and installing any hardware, carefully check Hardware Schedule, Drawings and Specifications. Verify door handles, door and frame material and operating conditions, and assure that hardware will fit work to which it is to be attached. Inform the Contract Administrator in writing of required revisions.

.6 Templates: Check Hardware Schedule, Drawings and Specifications, and Supply promptly to applicable Sections any templates, template information and manufacturer's literature, required for proper preparation for hardware, in ample time to facilitate progress of work.

.7 Provide services of competent mechanics for the installation of hardware. Make adjustments necessary to leave hardware in perfect working order. Provide written summary of work completed and status of all items, including any adjustments, revisions or modifications.

.8 Maintenance Seminar: Instruct the City regarding proper care, cleaning and general maintenance.

.9 Source Limitations: Obtain each type of product from a single Manufacturer.

1.2 Regulatory Requirements

.1 Ensure hardware for fire-rated openings complies with requirements of Authorities Having Jurisdiction, with door and frame manufacturer's tested assemblies, and that hardware items bear labels acceptable to Authorities Having Jurisdiction.

1.3 Shop Drawings, Submittals

.1 Shop Drawings for door hardware.

.2 Submit Shop Drawings for review in accordance with Section 01 33 00 – Submittal Procedures.

1.4 Maintenance Data

.1 Provide operation and maintenance data for door hardware for incorporation into maintenance manual specified in Section 01 78 00 – Closeout Submittals.

2. PRODUCTS

2.1 Materials

.1 Metal Finishes: Free from defects, clean and unstained, and of uniform colour.

.2 Fire Rated Doors: Meeting requirements of ULC as part of fire rated door assembly, with ULC or WHI label, or as acceptable to Authority Having Jurisdiction.

.3 Smoke Rated Doors: Meeting requirements of ULC as part of fire rated door assembly, with ULC or WHI label, or as acceptable to Authority Having Jurisdiction.

.4 Fasteners: Screws, bolts, expansion shields and other fastening devices as required for satisfactory installation and operating of hardware.

.5 Same finish as hardware to which it is to be fastened.

.6 Supply hardware complete with all necessary screws, bolts and other fastening of suitable size and type to anchor the hardware in position neatly and properly in accordance with the best practices and to the Contract Administrator 's approval.

.7 Fastenings: All fastenings shall harmonize with the hardware materials and finishes.

.8 Hardware for fire rated and labelled door and frame assemblies: ULC listed or as accepted by Authorities Having Jurisdiction.

.9 Hinges:

.1 All Doors: Full mortised, stainless steel, standard weight, three (3) knuckles, concealed ball bearing, stainless steel screws.

.2 Non Removal Pin: Out swinging exterior doors and where scheduled.

.3 Stamp hinge catalogue numbers on face of leaf of each hinge at factory to enable easy recognition of hinge material and manufacture after doors are hung.

.4 Where doors are required to swing to 180 degrees, Supply and Install hinges of sufficient throw to clear trim.

.10 Locksets:

.1 Backset: 125 mm for exterior doors, 70 mm for interior doors.

.2 Cylinders: Six (6) pin cylinders.

.3 Strikes: Stainless Steel, ANSI standard size with curved lip strikes for latch bolts and no lip strikes for dead locks. Provide complete with wrought boxes finished to match strike.

.11 Closers:

.1 Hydraulically controlled and full rack and pinion operation, clear anodized aluminum arm and full cover.

.2 Adjustable closing speed, latch speed and back check control.

.3 Adjustable swing power.

.4 Install all necessary attaching brackets, mounting channels, cover plates where necessary for correct application of door closers.

.5 Parallel arms at out swinging exterior doors and at interior doors.

.12 Lever design for Schlage ND series: Rhodes.

.13 Construction Keying:

.1 Equip lock cylinders in construction system.

.2 The construction key system to be inoperative once the City's keys are inserted in the cylinders.

.14 Kickplates:

.1 Length: 50 mm less than door width for single doors.

.2 Thickness: 1.3 mm, free of rough or sharp edges. Corners and edges to be slightly radiuses.

.3 Installation: 3M tape.

.15 Surface Bolts:

.1 Stainless steel top and bottom bolts.

.2 Dust free strikes.

.16 Door Stops:

.1 Provide floor stops for all interior doors: Manufacturer: Standard Metal; Model S100; 626 Satin Aluminum finish.

.2 Install floor stops in manner so as not to create a tripping hazard and allows maximum opening of doors.

.3 Supply and Install door stops of height to engage doors.

.17 Thresholds: Extruded aluminum, high seat, except flat saddle for barrier free application.

.18 Coiling Door Cylinder locks:

.1 Cylinders: Six (6) pin cylinders.

2.2 Keying System

.1 Keying system shall include keying alike except where noted otherwise, with cylinders adaptable to a Medeco3 Mechanical keying system. Coordinate keying system with the City prior to Shop Drawing submission.

The Construction Contractor will pay for a Locksmith to do final keying of locks after final completion. Construction Contractor will provide the City with twelve (12) Medeco keys for each differently keyed lock used in the Work.

3. EXECUTION

3.1 Preparation

.1 Trim undesignated openings with hardware of equal quality and design to that specified for similar opening.

.2 Furnish door and frame manufacturers with complete instructions and templates for preparation of their Work to receive hardware.

3.2 Installation

.1 Install finish hardware to template in accordance with manufacturer's written instructions. Do not modify finish hardware without manufacturer's written approval.

.2 Install finish hardware for fire rated doors in accordance with NFPA 80 requirements.

.3 Install finish hardware for smoke rated doors in accordance with NFPA 80 and NFPA 105 requirements.

.4 Install finish hardware secure, plumb, level, and true to line.

.5 Cut and fit to substrates avoiding damage and weakening. Reinforce attachment substrate as necessary for proper installation and operation.

.6 Size cut-outs so that hardware item completely covers cut-out.

.7 Mortise work to correct location and size without gouging, splintering, and causing irregularities in exposed finish work.

.8 Where cutting and fitting is required on substrates to be painted or similarly finished, install, fit, and adjust hardware prior to finishing.

.9 Remove hardware and place in original packaging.

.10 Re-install hardware after finishing operation is complete.

.11 Set, fit and adjust hardware according to manufacturer's templates and instructions. Hardware shall operate freely. Protect installed hardware from damage and paint spotting.

.12 Pre-drill kickplates and doors before attachment of plates. Apply with water resistant adhesive and countersunk stainless steel screws.

.13 Weatherstrip exterior doors. Install effectively to tightly seal entire perimeter of door. Secure in place with non-ferrous screws, in accurate alignment.

.14 Maintain integrity of weather seal at head of doors fitted with closers. Adapt weatherstripping as required to achieve specified performance and provide any necessary accessories.

.15 After installation of hardware under this Section, check opening units for correct fit and uniformity of space around perimeter of units, or between units. Provide smoothly operating opening units free from binding.

3.3 Field Quality Control

.1 Have hardware manufacturer’s representative visit site and submit written report of each visit to Site, giving storage conditions and installation details, date and name of hardware manufacturer's representative. Submit the written report in accordance with Section 01 33 00 – Submittal Procedures.

3.4 Adjustments and Cleaning

.1 Adjust and clean hardware according to manufacturer's written instructions.

.2 Continued Maintenance Service: Approximately six (6) months after the date of Final Completion, the installer, accompanied by hardware manufacturer’s representative, shall return to the Work and re-adjust every item of hardware to restore proper function of doors and finish hardware. Clean and lubricate operational items wherever required.

3.5 Extended Warranty

.1 Warrant work against defects in materials and quality of performance for a period of five (5) years from Substantial Completion for door closers and two (2) years from Substantial Completion for other hardware.

END OF SECTION

1. GENERAL

1.1 References

.1 ASTM E330/E330M Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

.2 ASTM C542 Standard Specification for Lock-Strip Gaskets.

.3 ASTM D790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

.4 ASTM D2240 Standard Test Method for Rubber Property - Durometer Hardness.

.5 ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.

.6 CAN/CGSB-12.1 Tempered or Laminated Safety Glass.

.7 CAN/CGSB-12.3 Flat, Clear Float Glass.

.8 CAN/CGSB-12.4 Heat Absorbing Glass.

.9 CAN/CGSB-12.8 Insulating Glass Units.

.10 CAN/CGSB-12.10 Glass, Light and Heat Reflecting.

.11 Glass Association of North America (GANA) Glazing Manual.

.12 Glass Association of North America (GANA) Standards Manual.

.13 CAN/ULC-S101: Standard Methods of Fire Endurance Tests of Building Construction and Materials.

.14 CAN/ULC-S104: Standard Methods for Fire Tests of Door Assemblies.

.15 CAN/ULC-S106: Standard Method for Fire Tests of Window and Glass Block Assemblies.

1.2 Performance Requirements

.1 Provide continuity of building enclosure vapour and air barrier using glass and glazing materials as follows:

.1 Utilize inner light of multiple light sealed units for continuity of air and vapour seal.

.2 Size glass to withstand wind loads, dead loads and positive and negative live loads.

.3 Limit glass deflection to flexural limit of glass but not over 1/200 with full recovery of glazing materials.

1.3 Shop Drawings

.1 Submit Shop Drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Indicate location of all glazing coatings, infill gases and location of label(s).

.3 Fire Rating Glazing Material:

.1 Each piece of fire-rated glazing material shall be labelled with a permanent logo including name of product, manufacturer, testing laboratory, fire rating period and safety glazing standards.

.2 Provide Manufacturer's installation guide or drawing(s) for the project specific wall substrate.

1.4 Quality Assurance

.1 Perform Work in accordance with GANA Glazing Manual IGMAC and GANA - Standards Manual for glazing installation methods.

1.5 Environmental Requirements

.1 Install glazing when ambient temperature is 10°C minimum. Maintain ventilated environment for twenty-four (24) hours after application.

.2 Maintain minimum ambient temperature before, during and twenty-four (24) hours after installation of glazing compounds.

2. PRODUCTS

2.1 Glass Materials

.1 Clear Glass: Float glass, annealed to CAN/CGSB-12.3M, glazing quality.

.2 Sealed insulated units: to CAN/CGSB-12.8.

.3 Tempered Glass: Clear, fully tempered: to CAN/CGSB-12.1M.

.1 Appearance: Must be tint-free, optically clear fire rated glazing.

2.2 Hermetically Sealed Window Units

.1 Fixed and Operable Window: Insulating Glass Units to CAN/CGSB-12.8, Double pane, 6 mm outer pane of clear tempered glass; 6 mm inner pane of annealed glass with low "E" coating on third surface from outside, soft or sputter coated, argon filled space; complete with architectural profile edge tech – super spacer of 13 mm for all exterior windows.

2.3 Interior Door Glass

.1 Fixed Window: 6 mm tempered clear glass.

2.4 Interior Fire Rated Door Glass:

.1 Fixed Window: minimum 6 mm Fire Rated Glazing.

2.5 Glazing and Sealing Compound Materials

.1 Sealant compound: one (1) component acrylic base, gun grade, selected colour.

.2 Setting blocks: neoprene, Shore “A” durometer hardness 70-90, sized to suit manufacturer’s specifications.

.3 Tremco 3 mm polyshim tape.

.4 Spacer shims: neoprene. Shore durometer hardness 50, 75 mm long x 24 mm thick (3 inch x 1 inch) x 9 mm (3/8 inch) high.

.5 Primer-sealers and cleaners: to glass Manufacturers recommendations.

.1 Glazing splines: resilient polyvinyl chloride (PVC) silicone, extruded shape to suit glazing channel retaining slot, black colour.

.2 Lock-strip gaskets: to ASTM C542.

3. EXECUTION

3.1 Examination

.1 Verify that openings for glazing are correctly sized and within tolerance.

.2 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.

3.2 Preparation

.1 Clean contact surfaces with solvent and wipe dry.

.2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.

.3 Prime surfaces scheduled to receive sealant.

3.3 Workmanship

.1 Remove protective coatings and clean contact surfaces with solvent and wipe dry.

.2 Apply primer-sealer to contact surfaces.

.3 Place setting blocks as per manufacturer’s instructions.

.4 Install glass, rest on setting blocks, push against tape or compound with sufficient pressure to ensure full contact and adhesion at perimeter.

.5 Install removable stops, avoiding displacement of tape or sealant, exert pressure for full continuous contact.

.6 Provide edge clearance of 3 mm minimum except where indicated otherwise.

.7 Insert spacer shims to centre glass in space. Place shims at 300 mm on centre, and keep 6 mm below sight line.

.8 Apply cap bead of sealant at exterior void.

.9 Apply sealant to uniform and level line, flush with sightline and tooled or wiped with solvent to smooth appearance.

.10 Do not cut or abrade tempered, heat treated or coated glass.

3.4 Exterior Glazing

.1 Combination method - tape/sealant:

.1 Cut glazing tape to proper length and set against permanent stops, 5 mm below sightline. Install horizontal strips first; extend over entire width of opening before applying vertical strips. Weld corners together by butting tape and dabbing with sealant.

.2 Fill gap between glass and applied stop with specified sealant to depth equal to bit of frame on glass but no more than 3 mm below sightline.

3.5 Fire Rated Glazing

.1 Installation shall be in strict accordance with the fire glazing material manufacturer's specifications. Field cutting or tampering is strictly prohibited.

3.6 Finishing

.1 Immediately remove sealant and compound dropping from finished surfaces. Remove labels after Work is completed.

3.7 Cleaning

.1 Remove glazing materials from finish surfaces.

.2 Remove labels after Work is complete.

.3 Clean glass.

END OF SECTION

GYPSUM BOARD

1. GENERAL

1.1 Work Included

.1 Interior finish.

1.2 Quality Assurance Project (Environmental Requirements)

.1 Maintain temperature minimum 10°C, maximum 21°C for forty-eight (48) hours prior to and during application of gypsum boards and joint treatment, and for at least forty-eight (48) hours after completion of joint treatment.

.2 Apply board and joint treatment to dry, frost free surfaces.

2. PRODUCTS

2.1 Materials

.1 Standard board: to ASTM C1396/C1396M thickness as indicated, 1200 mm wide x maximum practical length, ends square cut, edges bevelled. Utilize standard board in all areas except as noted.

.2 Steel drill screws: to ASTM C 1002.

.3 Adhesive: to ASTM C 557.

.4 Laminating compound: as recommended by manufacturer, asbestos-free.

.5 Casing beads, corner beads, and edge trim: to ASTM C 1047, metal with Z275 zinc finish, 0.5 mm base thickness, perforated flanges, one piece length per location.

.6 Joint compound: to ASTM C 475/C 475M, asbestos-free.

.7 Joint tape: to ASTM C 475/C 475M, asbestos-free.

.8 Furring Channel: to ASTM C645 Specification for Non-structural Steel Framing Members.

2.2 Acceptable Products

.1 Georgia-Pacific Building Products.

.2 CertainTeed Corporation.

.3 CGC Inc.

3. EXECUTION

3.1 Erection

.1 Do application and finishing of gypsum board in accordance with ASTM C 840 except where specified otherwise.

.2 Do application of gypsum sheathing in accordance with ASTM C 1280.

3.2 Application

.1 Do not apply gypsum board until bucks, anchors, blocking, electrical and mechanical Work are approved.

.2 Apply single layer gypsum board to framing using screw fasteners for first layer, laminating adhesive screw fasteners for second layer.

3.3 Installation

.1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Miter and fit corners accurately, free form rough edges. Secure at 150 mm o/c.

.2 Provide Level 4 Finish in accordance with ASTM C 840 for walls, fill screw head depressions and joints with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.

.3 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.

.4 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.

END OF SECTION

1. GENERAL

1.1 Summary

.1 Finish painting defined under this Section is to specify the general requirements of the Work and is applicable to items not covered under other Sections of this Specification.

1.2 Quality Assurance/Submittals

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

.2 Perform painting Work by applicator with minimum five (5) years of proven, satisfactory and successful painting experience on projects of similar size and nature. Provide qualified crew of painters and full time review of Work by qualified supervisor for duration of Work.

.3 Submit in writing list of proposed materials, for approval at least six (6) weeks before materials are required. List shall contain following for record:

.1 Manufacturer's product number, Master Paint Institute (MPI) Product Index Number and application instructions.

.2 Finish formula.

.3 Product type.

.4 Colour number.

.5 Maximum VOC classification.

.6 Ecologo certification where applicable.

.4 Samples: Submit at least four (4) weeks prior to painting Work commencing at the Site, two (2) identified (with Project Name, the finish, colour name and number, sheen and gloss values) samples of the following:

.1 Each colour in each finish coat material on minimum 150 mm x 300 mm coated stock card.

1.3 Environmental Requirements

.1 Comply with requirements of WHMIS regarding use, handling, storage, and disposal of hazardous materials; and material safety data sheets acceptable to Ministry of Labour.

.2 Ventilate area of Work by use of portable supply and exhaust fans. Provide continuous ventilation during and after application of paint. Run ventilation system twenty-four (24) hours per day during installation; provide continuous ventilation for seven (7) days after completion of application of paint. Apply paint finishes only when temperature at location of installation can be satisfactorily maintained within Manufacturer’s recommendations. Substrate and ambient temperature shall be within limits prescribed by Manufacturer.

.3 Provide heating to maintain minimum temperatures recommended by Manufacturers.

.4 Apply paint finish only in areas where dust is no longer being generated by related construction operations such that airborne particles will not affect the quality of the finished surface. Apply paint only when surface to be painted is dry, properly cured and adequately prepared.

.5 Protect floors by means of tarpaulins and metal pans.

1.4 Painting and Finishing Work Standards

.1 The best practices specified or recommended in MPI Architectural Painting Specification Manual are to govern for painting methods and procedures, unless specified otherwise in this Section.

1.5 Colour Selections

.1 Provide two (2) different top coat colours for each individual Room.

.2 Provide two (2) different top coat colours for all exterior Steel Door Frames (one (1) top coat for the exterior face and one different top coat for the interior face).

.3 Provide two (2) different top coat colours for all exterior Steel Doors (one (1) top coat for the exterior face and one different top coat for the interior face).

.4 Provide one (1) different top coat colour for all interior Steel Door Frames (one (1) top coat for both faces).

.5 Provide one (1) different top coat colour for all interior Steel Doors (one (1) top coat for both faces).

.6 Provide one (1) different top coat colour for all other wood and plywood unless noted otherwise.

.7 The Contract Administrator will issue a schedule indicating colour(s), colour locations, gloss value and sheen. Colour may be selected from an unlimited number of colours, gloss and sheen.

1.6 Extra Stock

.1 Prior to final completion, supply and deliver to the Site, 1 L of extra stock for products for which less than 45 L were used, 4 L of extra stock when from 45 to 180 L were used, and 10 L of extra stock when in excess of 180 L were used.

1.7 Maintenance Data

.1 Provide operation and maintenance data for each Formula for incorporation into maintenance manual in accordance with Section 01 78 00 - Closeout Submittals.

2. PRODUCTS

2.1 Painting, Finishing, and Coating Products

.1 Only materials (primers, paints, coatings, fillers, etc.) listed in the latest edition of the MPI Approved Product List (APL) are acceptable for use at this Site unless specifically noted in the schedule of Paint Formulas. All such material shall be from a single manufacturer for each system used.

.2 Design is based on Dulux and Carboline Coatings.

.3 Equivalent manufacturers for utilizing the same MPI Product Index Number as the ICI/Glidden design standard are the following:

.1 Sherwin Williams.

.2 Benjamin Moore.

.3 Pittsburgh Paints.

.4 Finishing products such as oils or putties not specified in this Section are to be premium quality and as recommended by the manufacturer of the paint or finish product it is associated with.

.5 On walls no defects shall be visible from a distance of 1000 mm at 90° to surface. On ceilings no defects shall be visible from floor to surface when viewed using final lighting source. Final coat shall exhibit uniformity of colour and uniformity of sheen across full surface area.

3. EXECUTION

3.1 Examination of Substrate

.1 Examine surfaces to receive paint or protective coating to ensure that they are in the proper condition to be painted or coated. Commencement of painting and protective coating Work will be interpreted as acceptance of the surface to receive the Work. Correction of defective painting or protective coating Work resulting from application to unsatisfactory surfaces will be the responsibility of the painting contractor.

3.2 Special Conditions

.1 Post "Wet Paint" signs throughout freshly finished areas and remove when finishes are dry.

.2 Prohibit traffic where possible, from areas where painting is being carried out until paint is cured.

3.3 Protection

.1 Cover or mask surfaces adjacent to those receiving treatment and finishing to protect the Work of others from damage and soil. Mask instruction and specification plates and controls attached to equipment being painted.

.2 Coordinate with the appropriate trades for the removal from finished surfaces, storage and reinstallation after finish Work is completed of finish hardware, switch and receptacle plates, escutcheons, luminarie frames, and similar items.

3.4 Preparation of Surfaces

.1 General:

.1 Vacuum clean areas inside the building(s) immediately prior to commencing finishing Work.

.2 Arrange for finishing hardware, electrical plates, accessories, and similar removable fittings on surfaces to be finished to be removed. Mask any other Work that is not removable.

.2 Cleaning Procedures:

.1 Surface preparation methods shall remove any contaminant that will interfere with full adhesion of protective painting and coating systems.

3.5 General Application of Paint and Finishes

.1 Maintain at the Site at all times until the Work is completed, a moisture meter, hygrometer, and thermometer to verify surface and environmental conditions.

.2 Make clean, true junctions with no overlap between adjoining applications of finish coatings.

.3 Unless otherwise specified, DO NOT apply paint or finish to the following:

.1 Finishing hardware.

.2 Equipment nameplates and other such identification.

.3 Switch, receptacle and other electrical device faceplates.

.4 Exposed copper, brass, plastic, acrylic and FRP unless otherwise specified.

.5 Lighting fixtures.

.6 Stainless steel except for stainless steel doors and frames.

.7 Chrome plated surfaces, and polished or lacquered brass or bronze surfaces.

.8 Surfaces factory coated with baked epoxy or enamel.

.9 Plastic laminate surfaces.

.10 Manhole and catch basin covers.

.11 Covers or strainers associated with floor drains, cleanout terminations, and similar equipment.

.12 Recessed electrical boxes and similar recessed equipment.

.13 Exterior poured concrete and masonry surfaces.

.14 Valve handles.

.15 Control panels.

.16 Electrical panels.

.17 Circuit breakers, switches, receptacles, and similar electrical devices.

.18 Exterior sealant joints.

.19 Pre-finished sheet metal flashing.

.20 Pre-finished exterior wall louvres.

.21 Pre-finished exterior metal soffit.

3.6 Paint Formula

.1 Apply paint to surfaces with the following:

.1 Interior wood including plywood:

.1 One (1) coat Dulux X-Pert Gripper (250) at 1.8 - 2.0 mils DFT.

.2 Minimum of two (2) coats Dulux Diamond Interior Acrylic Eggshell (14220). Each coat at 1.0 mils DFT per coat.

.2 Interior concrete block:

.1 Substrate cured to ASTM D4258.

.2 Primer: one (1) coat Carboguard 890 by Carboline at 6.0 – 8.0 mils DFT.

.3 Top coat: minimum of two (2) coats Carboguard 890 by Carboline. Each coat at 4.0 – 6.0 mils DFT per coat.

.3 All exterior Steel Doors and Frames:

.1 Exterior surfaces:

.1 Minimum preparation: SSPC-1.

.2 One (1) coat Dulux X-Pert Gripper (250) at 1.8 - 2.0 mils DFT.

.3 Minimum of two (2) coats Dulux Diamond Exterior Latex Semi-gloss (1650.501). Each coat at 1.2 mils DFT per coat.

.2 Interior surfaces:

.1 Minimum preparation: SSPC-3. Utilize SSPC-2 where SSPC-3 in not possible.

.2 Primer: one (1) coat Rustbond by Carboline at 1.0 – 2.0 mils DFT.

.3 Top coat: minimum of two (2) coats Carboguard 890 by Carboline. Each coat at 6.0 – 8.0 mils DFT per coat.

.4 All interior Steel Doors and Frames:

.1 Minimum preparation: SSPC-3. Utilize SSPC-2 where SSPC-3 in not possible.

.2 Primer: one (1) coat Rustbond by Carboline at 1.0 – 2.0 mils DFT.

.3 Top coat: minimum of two (2) coats Carboguard 890 by Carboline. Each coat at 6.0 – 8.0 mils DFT per coat.

.5 All interior miscellaneous metals:

.1 Minimum preparation: SSPC-3. Utilize SSPC-2 where SSPC-3 in not possible.

.2 Primer: one (1) coat Rustbond by Carboline at 1.0 – 2.0 mils DFT.

.3 Top coat: minimum of two (2) coats Carboguard 890 by Carboline. Each coat at 6.0 – 8.0 mils DFT per coat.

.6 Galvanized Bollards:

.1 Minimum preparation: SSPC-1.

.2 Two (2) coats Dulux X-Pert Gripper (250) at 1.8 - 2.0 mils DFT per coat.

.3 Minimum of two (2) coats Dulux Diamond Exterior Latex Semi-gloss (1650.501). Each coat at 1.2 mils DFT per coat. Colour: Safety Yellow.

.7 All overhead crane (includes runway beam and support frames):

.1 Minimum preparation: SSPC-6.

.2 Top coat: minimum of two (2) coats Carboguard 890 by Carboline. Each coat at 6.0 – 8.0 mils DFT per coat.

.8 Expose face of steel deck (all area):

.1 Primer: one (1) coat Rustbond by Carboline at 1.0 – 2.0 mils DFT.

.2 Top coat: minimum of two (2) coats Carboguard 890 by Carboline. Each coat at 6.0 – 8.0 mils DFT per coat.

3.7 Adjustment and Cleaning

.1 Touch-up and refinish minor defective Work. Refinish the entire surface where the finish is damaged or not acceptable, including areas exhibiting incomplete or unsatisfactory coverage. Patching will not be permitted.

.2 Remove spilled or splattered finish materials from surfaces of Work performed under other Sections. Do not mar surfaces while removing.

.3 Upon completion, remove masking and clean adjacent surfaces free of over spray spatters, drips, smears and over spray.

3.8 Disposal of Paint Waste

.1 Dispose paint that cannot be recycled as hazardous waste. Generators of hazardous waste shall be registered and disposal shall be in accordance with regulations of authorities.

END OF SECTION

FACTORY-APPLIED COATINGS

1. GENERAL

1.1 Work Included

.1 Supply and application of all factory applied prime coats or factory applied finish coats.

1.2 Submissions

.1 With the equipment Shop Drawings, submit details of the coating systems to be applied.

1.3 Quality Assurance

.1 This Specification is intended to be a minimum reference standard. The Construction Contractor may submit for review alternative coating systems for specific items of equipment which provide equal or better corrosion protection and maintenance service than those specified herein.

.2 Apply, cure, and handle coatings using procedures which produce a final product that complies to the manufacturer's published literature and performance testing conducted by the City.

.3 Ensure the finished coating is free of obvious defects such as runs, sags, blisters or pinholes, air entrapment, fish-eyes and foreign matter.

.4 Provide film thickness, as determined by a calibrated Mikrotest gauge or equivalent, in accordance with SSPC Good Painting Practice.

.5 Apply all immersion coating 100% holiday free.

.6 Conduct wet sponge holiday testing in accordance with proposed NACE Standard, "Holiday Detection of Internal Tubular Coatings" (less than 0.254 mm (10 mil) thickness).

.7 A "holiday" is an area of applied coating with electrical resistance less than 80,000 ohms as identified by a detection instrument connected to a clean sponge wetted with a solution of one teaspoon of detergent per 3.78 L of tap water.

.8 No immersion coating will be accepted or released from coating applicators until fully cured. Cure test will be performed using the M.E.K. rub test in conjunction with a time and temperature relationship for the coatings being used.

.9 Repair or replace at the Construction Contractor's expense any coating not meeting the requirements of this Specification.

2. PRODUCTS

2.1 Surface Preparation

.1 Immersion Service: after degreasing, dry blast all ferrous components to a white metal finish in accordance with SSPC SP 5 to a degree of cleanliness in accordance with NACE No. 1 and obtain a 50 micron blast profile.

.2 Non-immersion Service: after degreasing, dry blast all ferrous components to a near white finish in accordance with SSPC SP 10 to a degree of cleanness in accordance with NACE No. 3 and obtain a 50 micron blast profile.

2.2 Prime Coating

.1 Prime coat all ferrous surfaces before the blasted surfaces deteriorate.

.2 Coat ferrous surfaces with inorganic zinc primer, containing a minimum of 50% solids by volume, applied to a minimum dry film thickness of 75 microns.

2.3 Finish Coats

.1 Except as otherwise specified in other Divisions, apply finish coats in conformance with SSPC Guide “Using SSPC Coating Material Standards” and SSPC Standards for coating systems specified therein.

2.4 Assembly

.1 For items which are to be bolted together before shipment, clean surfaces and coat before the parts are assembled.

.2 Continuous weld all welded connections, sealing the mating surface completely. On completion of the welding and fettling, treat all weld seams with phosphoric acid solution. Rinse and thoroughly dry before the prime is applied.

.3 Where dissimilar metals are mated insulate the mating surfaces from one another to provide protection against corrosion. Insulate bolts, nuts, washers and rivets in a similar manner.

.4 Use Type 304 stainless steel or better for all nuts, bolts, washers and similar fittings for immersion service. For non-immersion service, use Type 304 stainless or zinc or cadmium plated nuts, bolts, washers, and similar fittings. Clean and coat the inner face of non-threaded bolt holes as required for other surfaces.

3. EXECUTION

3.1 Inspection

.1 Notify the Contract Administrator two (2) weeks before commencing the protective coating to permit the inspection by the Contract Administrator of the surface preparation and protective coating application.

3.2 Protection

.1 Protect all coated equipment adequately against damage, dust, moisture and scratching during shipment, off-loading and storage on-site. If, in the opinion of the Contract Administrator the coating is damaged during shipment to the extent that touch-up would not be satisfactory, return and re-coat the equipment at the Construction Contractor's cost.

.2 Make good damage to coatings occurring at any time prior to the application of any further coatings.

3.3 Application Conditions

.1 Apply all factory applied coatings under controlled conditions, in a dust-free atmosphere at a temperature of between 10°C and 20°C, and a relative humidity should not exceed 80%.

END OF SECTION

1. GENERAL

1.1 Work Included

.1 Provide, apply, and maintain the specified field applied protective and maintenance coating systems. Coatings are required on all process and mechanical equipment, vessels and pipes unless specifically deleted.

.2 Refer to Drawings and schedules for the type, location and extent of coatings required and include for all field coating necessary to complete all the Work shown, specified or scheduled.

1.2 Reference Standards

.1 Reference to the SSPC Good Painting Practice and the National Association of Corrosion Engineers specifications refers to the latest edition of these specifications.

.2 Apply all coating in accordance with manufacturers' recommendations, and to SSPC Standard. Specifications contained therein take precedence over manufacturers' recommendations.

.3 Strictly observe all safety rules and regulations of the City, applicable governing bodies, and insurance underwriters in the storage, handling, use and application of coating system material, solvents, and cleaning agents.

.4 Employ qualified and competent personnel to perform the Work in a neat and workmanlike manner, conforming to all City and Government Safety Standards and Regulations.

1.3 Shipment, Protection, and Storage

.1 Deliver all materials to the site in sealed containers properly labeled as to the manufacturer's name, type, and colour of contents, date of manufacture, batch number, storage requirements, and shelf-life.

.2 Provide adequately ventilated storage for all materials and ensure compliance with fire prevention regulations.

1.4 Guarantee

.1 Furnish to the City a two-year guarantee from Substantial Completion in an approved format, or alternatively a 100% two-year maintenance bond, on completion of the work. The Work performed by the Construction Contractor shall be inspected by an independent inspector acceptable to the Contract Administrator. Include the cost of this inspection and the guarantee or maintenance bond in the Bid Price.

1.5 Restrictions

.1 Regardless of whatever else is specified in this Section, no paint containing a chromate based additive can be used. Substitute products of equal or greater quality.

2. PRODUCTS

2.1 Manufacturers

.1 All constituents of each coating system are to be provided by the same manufacturer.

2.2 Coating Application

.1 Use application methods in accordance with the coating manufacturer's recommendation for the particular coating being applied, and the requirements of SSPC Good Painting Practice.

.2 Provide traps or separators to remove oil and water from the air, so that the air from the spray gun impinging onto the steel substrata shows no condensed water or oil.

.3 Hand brush all welded and hard-to-spray areas prior to the first spray coat application, with coating mixed to manufacturer's recommended procedures.

.4 Coat by brush, roller, sheepskin dauber, or other suitable method, all areas inaccessible to the spray gun.

.5 Do not apply coatings to a surface at a temperature that will cause blistering, separation or otherwise be detrimental to the life of the coating.

.6 Only thinners specified by the manufacturer are acceptable.

.7 Materials that exceed manufacturer's published shelf life are not acceptable.

.8 Immediately brush out all runs, sags, blisters, etc., or remove and repair the area prior to the next application.

.9 Apply the coating using a 3-coat, 2-colour system.

.10 Apply coating by conventional or airless spray as power coating manufacturer's data sheet.

.11 Follow manufacturer's application procedures as closely as possible as to recommended pressures, atomization, etc.

.12 Provide final dry film coating thickness in accordance with the coating manufacturer's specification.

.13 Apply the coating 100% holiday free.

2.3 Drying and Curing

.1 Accommodate all drying and re-coat times in accordance with the manufacturer's specifications.

.2 Cure in accordance with the manufacturer's recommended specifications. Force curing specifications are available from manufacturer if required.

.3 Supply indirect fired heaters and ducting as required to maintain drying and curing temperatures during coating operations.

2.4 Quality Control and Acceptance

.1 Apply, cure, and handle coatings using procedures which produce a final product that complies to the manufacturer's published literature and performance testing conducted by the City.

.2 Ensure the finished coating is free of obvious defects such as runs, sags, blisters or pinholes, air entrapment, fish-eyes and foreign matter.

.3 Provide film thickness, as determined by a calibrated Mikrotest gauge or equivalent, in accordance with SSPC Good Painting Practice.

.4 Apply all immersion coating 100% holiday free.

.5 Conduct wet sponge holiday testing in accordance with proposed NACE Standard, "Holiday Detection of Internal Tubular Coatings" (less than 0.254 mm (10 mil) thickness).

.6 A "holiday" is an area of applied coating with electrical resistance less than 80,000 ohms as identified by a detection instrument connected to a clean sponge wetted with a solution of one teaspoon of detergent per 3.78 L of tap water.

.7 No immersion coating will be accepted or released from coating applicators until fully cured. Cure test will be performed using the M.E.K. rub test in conjunction with a time and temperature relationship for the coatings being used.

.8 Repair or replace at the Construction Contractor's expense any coating not meeting the requirements of this Specification.

2.5 Surface Treatment

.1 Remove all organic substances such as oil, grease, paraffin, etc. in accordance with SSPC-1, "Solvent Cleaning", prior to commencement of sandblast cleaning operations.

.2 Provide proper traps or separators to remove all oil and water from the air supply. The air from the blast nozzle is to be free of condensed water or oil that will impinge onto steel substrata. In high humidity areas, the use of air dryers may be required.

.3 Do not blast surfaces when surface temperatures are less than 10°C, when substrata is less than 3°C above the dew point, when the relative humidity is greater than 80% or when there is a possibility that the blasted surface will be subject to wetting prior to the primer coat being applied.

.4 Blow down all surfaces with clean, dry air; brush and vacuum free of dust before the surface is primed.

.5 Do not blast more surface than can be prime coated before visible or detrimental re-rusting occurs.

.6 Use siliceous sand, free of dirt, clay or other foreign material, graded 16/30 or 20/40 mesh to give an anchor pattern 0.038 mm to .076 mm (1.5 to 3.0 mil).

2.6 Schedule of Surface Treatments

.1 The schedule of Surface Treatments defines the components of the protective coating systems.

Reference	Description	Surface Treatment
A	Solvent Cleaning	as SSPC – SP1
B	Hand Tool Cleaning	as SSPC – SP2
C	Power Tool Cleaning	as SSPC – SP3
D	Brush Blast	as SSPC – SP7
E	Near White Metal Blast	as SSPC – SP10
F	White Metal Blast	as SSPC – SP5 (NACE #1)
G	Abrasion	The surface shall be lightly abraded using steel wool or abrasive cloth to provide a key for the next coat, to remove runs or excessive brushmarks
H	Vinyl Wash Primer	DFT 13 micron To be overcoated within twenty-four (24) hours
I	Water-borne Acrylic Primer	Nominal DFT 40 micron
J	Inorganic Zinc Primer	Zinc in ethyl silicate vehicle Minimum DFT 40 micron
K	Industrial Enamel (to 100°C)	To CGSB 1-GP-61M Alkyd Enamel Minimum DFT 40 micron
L	High Build Epoxy	Black Polyamine cured Minimum DFT 200 micron
M	Bituminous Paint	To AWWA C230 MIL-P-151470
N	Silicone Alkyd (100°C to 150°C)	Minimum 60% Solids by Wt Nominal DFT 25 micron
O	Silicone Enamel (150°C to 400°C)	To CGSB 1-GP-143M Nominal DFT 40 micron
P	Fast Drying Aluminum Sealer	To CGSB 1-GP-69M Nominal DFT 25 micron
Q	Canvas Insulation Sealer	Acrylic or PVA Latex
R	Epoxy Gloss Enamel	To CGSB 1-GP-146 Nominal DFT 50 micron
SSPC: Steel Structures Painting Council Pittsburgh PA 15213 Surface Preparation Specifications 1985		

2.7 Schedule of Protective Systems

.1 The schedule of protective systems defines the combination of surface treatments required in each system and the sections of the plant to which it is to be applied. The systems have been grouped into three (3) categories as follows:

.1 Category A: Immersed Service - equipment or material fully, partially or intermittently immersed in sewage during routine plant operation.

.2 Category B: Exposed Service - equipment or material exposed to the normal range of atmospheric conditions and conditions common to sewage treatment facilities (high humidity, H_2S, etc.)

.3 Category C: Indoor Service - equipment or material inside buildings or other ventilated spaces.

2.8 Category A

.1 Category A: all category A systems will be tested by the Contract Administrator using a wet sponge holiday detector set at 67.5 V. Touch-up will be required at points where the detector is grounded.

Reference	Surface Treatments	Typical Applications
A1	A, D, I, L	Equipment or piping delivered with inorganic zinc primer, e.g., clarifier mechanisms, mixers, etc.
A2	A, F, J, L ,L	Equipment or piping delivered uncoated or with coatings not compatible with high build epoxy, e.g., ductile iron, cast iron or steel pipe and pipe sleeves inside treatment units. External surfaces at valves, ferrous weir plates, weirs, penstocks, fabricated pipe supports, brackets, etc.
A3	A, G, M	Aluminum surfaces in contact with concrete, e.g. stop log guides, access cover frames.
A4	A, E	Ferrous metal surface cast concrete, e.g., penstocks, sluice gates.
A5	A	Stainless steels, plastics, and fiberglass products.
A6	A, E, J, M, M	Ferrous metal immersed in abrasive environment, listed below: - grit tanks.

2.9 Category B

.1 Schedule:

Reference	Surface Treatments	Typical Applications
B1	A, B, R, R	Equipment or piping delivered with inorganic zinc primer, e.g. clarifier motor, gearbox and motor, valve headstocks, piping above ground and outside treatment units, hydrants, etc.
B2	A, B, J, R ,R	Equipment or piping delivered not supplied with an inorganic zinc prime coat or with a prime coat not compatible with an inorganic zinc overcoat.
B3	A, G, R, R	Equipment delivered with factory applied paint which is to be painted for identification only.
B4	A	Stainless steel or aluminum products, e.g. insulation recovering.

2.10 Category C

.1 Schedule:

Reference	Surface Treatments	Typical Applications
C1	A, B, K, K	Equipment or piping delivered comes with factory finished coatings. Coated for system identification and maintenance. Surface temperature during operation not exceeding 100°C, e.g., pumps, air handling units, valves, etc.
C2	A, G, K, K	Equipment or accessories fully primed. Surface temperatures not exceeding 100°C, e.g. pumps, steel piping.
C3	A, C, I, N, N	Equipment or accessories as C1 or C2 but with operating surface temperatures between 100°C and 150°C, e.g. air compressors, blowers.
C4	E, J, O	Equipment or accessories as C1 or C2 but with operating surface temperatures between 150°C and 400°C, e.g. boiler fittings.
C5	B, P, K, K	Piping or valves with bituminous or tar coatings. Surface temperatures not exceeding 100°C, e.g., cast iron and ductile iron pipe, valves.
C6	A, K, K	PVC pipe, fittings or accessories, coated for identification only.
C7	A, H, K, K	Aluminum insulation recovering coated for identification only.
C8	A, Q, G, N, N	Canvas insulation recovering.

NOTES: (1) Surface preparation "G" abrasion, has not been fully scheduled but is to be carried out between all coatings.
(2) No bare ferrous metal surfaces are permitted. Pipe hangar rods etc. unless zinc or cadmium plated are to be at least prime coated. Cut ends of plated surfaces (Uni-Strut, etc.) are to be spot primed.

2.11 Acceptable Products

.1 Amercoat Ltd.

.2 Carboline.

.3 General Paints Ltd.

.4 ICI Paints Ltd.

.5 Plasite.

.6 Rust Oleum.

.7 Valspar.

3. EXECUTION

3.1 Quality Assurance

.1 Apply and cure all paints and coatings strictly in accordance with the manufacturer's directions.

.2 Pay particular attention to ensure the compatibility of each surface treatment with the preceding and subsequent surface treatment and coatings. Be responsible for the compatibility of all surface treatments and coatings.

3.2 Environmental Conditions

.1 Apply no coating when the ambient or surface temperature is below 10°C or less than 3°C above the dew point.

.2 Provide a minimum of 300 lux illumination on surface to be treated.

.3 Do not apply coatings where dust is being generated.

3.3 Protection

.1 Provide sufficient drop cloths, shields and protective equipment to prevent spray or droppings from fouling surfaces not being painted. Make good any damage resulting from inadequate or unsuitable protection.

.2 Maintain all coated surfaces until completion of the Work. Make good within seven (7) days any damage to coatings.

.3 Place cotton waste, cloths, and material which may constitute a fire hazard in closed metal containers and remove from the site at suitable intervals.

.4 Adequately mask, or remove and replace after painting, all grease nipples, bright metal surfaces, identification plates and other items not to be painted. Do not use solvent that may remove permanent lacquer finishes.

3.4 Condition of Surfaces

.1 Prior to starting Work, thoroughly examine all surfaces to be treated or coated. Report, in writing, to the Contract Administrator any condition or defect that may affect the integrity or quality of the finished coating. Do not start Work on any section until all such defects in that section have been corrected.

.2 On all factory primed or coated equipment, touch-up defects prior to the application of subsequent coatings.

.3 Be responsible for the condition of surfaces and for correcting defects and deficiencies in the surface.

3.5 Inspection

.1 The Contract Administrator has the right to request tests, to witness the performance of tests, or to perform tests.

.2 Such inspection does not relieve any responsibility for guarantee of the coating application from the Applicator.

3.6 Clean-Up

.1 After acceptance of coating, remove all masking, grease, etc., from all equipment which was not intended to be coated.

.2 Remove all unused material, containers, etc., from the site upon completion of Work.

END OF SECTION

1. GENERAL

1.1 Work Included

.1 Supply and installation of specialty coatings for concrete.

.2 Third Party Testing.

1.2 Qualification

.1 Installation is to be done by an established firm having at least ten (10) years of proven, satisfactory experience in this trade and employing certified personnel. The firm is to be authorized by the coating manufacturer to install the specified product and product line.

.2 Submit proof of qualifications and authorization in writing to the Contract Administrator, four (4) weeks prior to commencement of Work.

1.3 Design Standards, Code Requirements

.1 Conform to requirements of The Society for Protective Coatings (SSPC) Publications, explanatory notes, comments and appendixes:

.1 SSPC-PA-1 Shop, field and maintenance painting.

.2 SSPC-SP-1 Solvent cleaning.

.3 SSPC-SP-2 Hand cleaning.

.4 SSPC-SP-3 Power tool cleaning.

.5 SSPC-SP-5 White Metal Blast Cleaning.

.6 SSPC-SP-6 Commercial blast cleaning.

.7 SSPC-SP-7 Brush off blast cleaning.

.8 SSPC-SP-10 Near white metal blast cleaning.

.9 SSPC-SP-13 Surface Preparation of Concrete.

.2 Concrete profile to: International Concrete Repair Institute (ICRI) visual standards.

1.4 Submittals

.1 Submit Shop Drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit colour samples of coating, minimum colour sample size 50 mm x 100 mm. Colour to be chosen by the Contract Administrator from manufacturer’s standard colour chart.

.3 Indicate location of where the specific coating is to be applied.

.4 Submit manufacturer's product data sheets and installation guides. A minimum of one (1) copy of the reviewed product data sheets and installation guides shall remain on-site at all times for all to view.

1.5 Inspection and Testing

.1 Allow ample time for notification, review, and corrective Work, if required, before scheduling coating installation.

.2 Inspection, and testing is to be performed by a CSA or SSPC certified inspection and testing firm. Testing of substrate required to be preformed prior to the application of the coating and while the coating is being applied and curing is to be paid for by the Construction Contractor. Testing of coating once the coating is cured, will be paid for by the City. Provide unencumbered access to all portions of Work and cooperate with appointed firm.

.3 Notify the Contract Administrator at least forty-eight (48) hours in advance of any coating installation or final substrate preparation.

.4 Repair all areas where concrete surfaces and coatings were tested.

.5 Testing of concrete will be performed in accordance with the indicated SSPC design standards. Test results are to be issued to the Construction Contractor, the Contract Administrator, and the City.

.6 The Construction Contractor is to pay costs for required retesting due to defective materials or workmanship.

.7 A minimum of one (1) SSPC test (surface tensile strength, surface profile confirmation, surface cleanliness and moisture content-ASTM D 4263) is to be performed in each room (prior to the application of the coating) unless noted below:

.1 Stair 1 three (3) tests.

.2 Loading Bay three (3) tests.

.3 Mechanical Room two (2) tests.

.4 Electrical Room two (2) tests.

.5 Polymer Room three (3) tests.

.6 Dewatering two (2) tests.

.8 A minimum of one (1) SSPC tests (surface tensile strength), is to be performed in each room (after application of the coating is cured) unless noted below. Location(s) of the test is to be coordinated with the Contract Administrator as so minimize visual impact of the tested area:

.1 Stair 1 three (3) tests.

.2 Mechanical Room two (2) tests.

.3 Loading Bay two (2) tests.

.4 Polymer Room two (2) tests.

1.6 Maintenance Data

.1 Provide operation and maintenance data for each Formula for incorporation into maintenance manual in accordance with Section 01 78 00 - Closeout Submittals.

2. PRODUCTS

2.1 General

.1 The same manufacture is to be used for the entire project.

.2 Colour Selections:

.1 Provide seven (7) different top coat colours for Formula 10.

.3 Abbreviations; P = primer, I = intermediate coat, TC = tack coat, SC = saturant coat and F = finish coat, DFT = dry film thickness, WFT = wet film thickness.

.4 Coating Formulas:

.1 All concrete floors, concrete curbs and housekeeping pads except as noted below: Formula 10.

.2 Chemical room floors: Formula 30.

.5 Formula Designations:

.1 Formula 10:

.1 Preparation: SSPC-13, Table 1, Light Service. Surface Profile: ICRI CSP 2–CSP 4.

.2 Coating system:

.1 Caroguard 890 by Carboline.

.2 Horizontal surfaces:

.1 P = 890 at 6-8 mils DFT.

.2 I = 890 at 6-8 mils DFT.

.3 TC = 890 at 6-8 mils DFT.

.3 Vertical curbs and housekeeping pad surfaces:

.1 P = 890 at 6-8 mils DFT.

.2 TC = 890 at 6-8 mils DFT.

.4 Floor and curb intersections and curb inside corners: infilled with Carboguard 510, blended with Portland Cement (TYPE I) and sand as required to provide minimum 25 mm radius.

.2 Formula 30:

.1 Preparation: SSPC-13, Table 1, Severe Service. Surface Profile: ICRI CSP 4 or 6.

.2 Coating system:

.1 Semstone 145 by Carboline.

.2 Horizontal surfaces:

.1 P = Semstone 110 at 8-10 mils DFT.

.2 F= Semstone 145 at 30 mils DFT.

.3 Vertical surface of concrete curbs:

.1 P = Semstone 110 at 8-10 mils DFT.

.2 I (void filler) = Semstone 110 Blended with fine silica and Semstone Thixotrope Part “D”. Intermediate coat to thickness required to fill voids flush to remaining surface.

.3 F= Semstone 145 at 30 mils DFT.

.4 Floor and curb intersections and curb inside corners: infilled with Carboguard 510, blended with Portland Cement (TYPE I) and sand as required to provide minimum 25 mm radius.

3. EXECUTION

3.1 Pre-Installation Conference

.1 Pre-installation conference for specialty coating products: prior to installation of specialty coating products, conduct a meeting with applicator, installers of Work adjacent to or that penetrates the specialty coating products, the Contract Administrator and manufacturer’s technical representative to review the following:

.1 General project requirements.

.2 Manufacture’s product data sheets and installation guides.

.3 Substrate conditions, moisture content, procedures for substrate preparation, and product installations.

.4 The manufacturer’s technical representative shall issue reports to the Contract Administrator confirming that the substrate conditions and installation procedures are being followed for each room were the specific product is being utilized.

.5 Responsibility and costs associated with verification and correlation of field dimensions, fabrication processes, techniques of construction, installation, and coordination of Work and manufacture's technical representative for all parts of the Work rests with the Construction Contractor.

.6 Construction Contractor to generate and distribute meeting minutes to all meeting attendants, the City and Contract Administrator within two (2) days of the meeting completion.

3.2 General

.1 Notify the Contract Administrator of any conditions which would prejudice proper installation of this Work.

.2 Commencement of this Work implies acceptance of existing conditions.

.3 Apply each coat of paint as a continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.

.4 Remove concrete spatter and droppings before coating is applied.

.5 Remove defective or damaged coatings as required by the Contract Administrator. Cost for defective or damaged coating removal and replacement will be at the Construction Contractor's expense.

.6 Areas designated as Severe Service preparation: Relative humidity of the concrete surface is to conform to SSPC-SP13 Table 1- Severe Service, using the ASTM D 4263 test method.

.7 Areas designated as Severe Service preparation: Concrete surface tensile strength shall be 2.1 MPa minimum for areas. Remediation of the concrete for values lower than 2.1 MPa will be at the Construction Contractor's expense.

.8 Areas designated as Light Service preparation: Relative humidity of the concrete surface is to conform to SSPC-SP13 Table 1- Light Service, using the ASTM D 4263 test method.

.9 Areas designated as Light Service preparation: Concrete surface tensile strength shall be 1.4 MPa minimum for areas. Remediation of the concrete for values lower than 1.4 MPa will be at the Construction Contractor's expense.

.10 Remediate areas where destructive pull tests have occurred. Remediate area in accordance with the coating manufacturer's written instructions to the satisfaction of the Contract Administrator.

.11 Terminate coatings in accordance with the coating manufacturer's written instruction.

3.3 Protection

.1 Protect other surfaces from substrate preparation, coatings and damage. Repair damage.

.2 Furnish drop cloths, shields, and protective methods to prevent spray or droppings from disfiguring other surfaces.

.3 Collect waste, cloths and material which may constitute a fire hazard, place in closed metal containers and remove daily from site.

3.4 Brush Application

.1 Work paint into cracks, crevices and corners and paint surfaces by brush.

.2 Brush out runs and sags.

.3 Remove runs, sags and brush marks from finished Work and repaint.

3.5 Spray Application

.1 Provide and maintain specialized equipment that is suitable for intended purpose, capable of properly atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.

.2 Provide traps or separators to remove oil and water from compressed air and drain periodically during operations.

.3 Keep paint ingredients properly mixed in spray pots or containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.

.4 Apply paint in uniform layer, with overlapping at edges of spray pattern.

.5 Brush out immediately runs and sags.

.6 Use brushes to work paint into cracks, crevices and places which are not adequately painted by spray. In areas not accessible to spray gun, use brushes, daubers or sheepskins.

.7 Remove runs, and sags marks from finished Work and repaint.

3.6 Warranty

.1 Provide a five (5) year warranty against delamination of the coating, delamination of the coating from the concrete substrate, defective coating application and defects in the coating.

END OF SECTION

1. GENERAL

1.1 Work Included

.1 This Section covers the supply and installation of permanent identification nameplates, labels and markers for mechanical and heating, ventilation, and air conditioning (HVAC) equipment, pipework, gates, and valves.

.2 Requirements for the supply and installation of permanent identification nameplates, labels and markers for electrical equipment, panels, process equipment, tanks and instruments are specified further in detailed specification.

1.2 Standards

.1 CAN/CGSBA 24.3 – Identification of Piping Systems.

.2 CGSB 1-GP-12 – Standard Paint Colours.

.3 WWD Identification Standard.

.4 WWD Painting Colour Standard.

1.3 Submittals

.1 Submit product data in accordance with Section 01 33 00.

.2 Sixty (60) Calendar Days prior to commencing any site commissioning activities submit the following:

.1 A typed copy of Nameplate Schedule for mechanical and HVAC equipment, pipework, valves, electrical equipment, panels, and instruments as identified in the equipment list and in the instrument index. Submit separate schedule for each circuit breaker panel. Include panel or motor control centre (MCC) control devices (e.g., signal conditioners, relays, timers) mounted within the enclosures and not listed on the equipment list but identified on motor control schematics and/or instrument loop diagrams. Submit separate legend/schedule for each panel and MCC control device. Identify Nameplate Schedule as "Preliminary".

.2 A Marker/Legend Schedule to be provided for all pipework commodities.

.3 A typical engraved sample of nameplates for Equipment, Instruments and valves,

.4 Typical pipe marker samples with identification label and directional arrow.

.3 A minimum of forty (40) Business Days prior to equipment checkout completion, submit Nameplate and Marker Schedules and a list of all pipes by commodity and their corresponding painting colour for approval by the Contract Administrator.

2. PRODUCTS

2.1 Equipment Manufacturer's Nameplates

.1 Provide nameplate on each piece of equipment, factory applied, mechanically fastened with raised or recessed letters.

.2 Provide nameplates made of brass or stainless steel. Select material that is suitable for the material and the environment such that they last as long as the equipment or instrument they are identifying.

.3 Provide ULC or CSA registration plates, as required by respective agency.

.4 Manufacturer’s nameplates to indicate size, equipment model, Manufacturer’s name, serial number, voltage, cycle, phase, power of motors, electrical characteristics, and other pertinent information for any other services connections.

.5 Nameplates to be located so that they are easily read. Do not insulate or paint over nameplates.

.6 Include other information as required by the equipment Specifications.

.7 Install markers as required to mark equipment and items securely and in highly visible locations.

.8 Provide markers that are suitable for the material and the environment such that they last as long as the item they are marking.

2.2 Equipment and Instrumentation – Project Identification Nameplates

.1 Supply and install white lamicoid identification plates, with black lettering, for all equipment and instrumentation installed under this contract. Provide identification plates that are engraved with the unit name and equipment number in 12 mm high lettering and electrical characteristics, if applicable, in 6 mm high lettering, as shown in the following example:

ISOLATION SLUICE GATE
SG-Z100

600V/3PH/60HZ

CIRCUITS A101, A102, A103

.2 Submit list of plates for review prior to engraving.

.3 Nameplates should be at least 2 mm thick, unless otherwise authorized by the Contract Administrator.

.4 For clarity, the specified nameplates in this specification are in addition to the equipment nameplates provided by the supplier.

2.3 Valves

.1 Provide all valves with a white lamicoid tag, with 12 mm black engraved names and numbers.

.2 If valve tags will be installed greater than 2.4 m above ground level, then increase the font on the tag to 14 mm.

.3 Number valves as directed by the Contract Administrator or as shown on the Drawings.

.4 Attach tags to valves using fasteners. Adhesive mounts are not acceptable.

.5 If fasteners cannot be used to attach a valve tag, then attach the valve tag using a durable stainless-steel chain unless otherwise directed by the Contract Administrator.

2.4 Piping

.1 For all piping installed under this Contract, use pipe markers designating the pipe service and the direction of flow.

.1 Apply intermittent markings on straight pipe runs, close to all valves, fittings, or junction boxes and adjacent to all changes in direction or where pipes pass through walls or floors.

.2 Adjacent to major valves and where valves are in series at no more than 5 m intervals.

.3 On both sides where piping passes through walls, partitions, and floors.

.4 At point of entry and leaving each pipe chase and/or confined space and piping accessible at each access opening.

.5 At the beginning and end points of each run; and, at each piece of equipment in each run.

.2 For above ground pipework and exposed conduit, provide mechanically attached type background colour markers that are easily removable.

.3 For underground pipework and conduit, provide stretchable polyethylene ribbon or detectable ribbon laid a minimum of 150 mm above the buried pipe. All ribbon to be detectable by standard utility location equipment, or additional tracer wire to be required.

.4 Identification arrows, labels and letters to painted on the pipes. Use white colour paint for arrows and identification marker label on dark colour painted pipes and black colour paint for arrows and identification marker label on light colour painted pipes.

.5 Make direction arrows 150 mm long x 50 mm wide for piping with an outer diameter 75 mm or larger, including insulation. Use 100 mm long x 20 mm wide arrows for smaller diameter piping. Provide double headed arrows where appropriate.

.6 Use block capital letters for names, 50 mm high for piping with an outer diameter 75 mm or larger, including insulation. Use 20 mm high letters for smaller diameters. Identify the pipe commodity using the full names detailed on the Drawings.

.7 Use stainless steel tags for pipes and tubing with an outer diameter 20 mm and smaller.

2.1 Colour Coding

.1 Use a colour coded identification system on the following items:

.1 All piping and valves: Fully paint the piping with the colours agreed prior to the work, paint the valves in the colour of the system, other than valves on fire protection systems. Paint the valves on fire protection systems red.

.2 All pumps: paint pumps in the colour identifying the material being pumped.

.3 All motors: paint all motors grey.

.4 Identification of pipes by bands is permitted only if pipe painting is determined non-feasible by the Contract Administrator.

.5 All painting of pipes, valves, motors, pumps, and other equipment shall follow the WWD Paint Colour Standard.

.6 Paint products shall be low VOC (Volatile Organic Compound) or water based wherever possible.

.2 Identification shall consist of the following:

.1 Coating or banding of pipes and coating of valves to the colour of the medium being conveyed.

.2 Coat non-submerged process equipment to match the colour requirement of the material being processed.

.3 Finish valve handles and similar appurtenances in black.

.3 Select identification colours in accordance with the colour scheme specified in WWD Paint Colour Standard.

.1 For commodities not listed, submit recommendation for review by the Contract Administrator.

.2 A list of Commodities that are used on this project but not listed in WWD Paint Colour Standard is provided below for the Contractor to recommend painting colour and submit for review and approval:

Commodity	Commodity symbol
Dewatered Scum	SCD
Drain	DRA
Exhaust Air	EA
Filtrate	FLT
Foul Air	FOA
Mixed Polymer	MP
Non – Potable Water	W2
Outside Air	OA
Process Overflow	PO
Sanitary	SAN
Tempered Water	TW

3. EXECUTION

3.1 Equipment Manufacturer's Nameplates

.1 Locate nameplates so that they are easily read. Do not insulate or paint over plates.

3.2 Equipment Project Identification Nameplates

.1 Attach plates to the equipment with rivets, sheet metal screws, or nuts and bolts, or 2-part epoxy adhesive, in a location approved by the equipment manufacturer and nameplate manufacturer.

.2 Fasten plates in conspicuous locations. Where plates cannot be mounted on hot or cold surfaces, provide standoffs.

.3 Fastening/ attachment of identification plates shall not compromise the safety and functionality of the equipment.

3.3 Valves

.1 Attach tags to all valves with high durability stainless steel chain or nuts and bolts. Ensure tags are easily accessible from operator location and do not conflict with valve operation.

3.4 Piping

.1 On completion of protective coatings or finish painting, neatly stencil direction flow arrows and the commodity abbreviation on the pipe.

.2 Stencil or attach pipe markers in readily visible locations. Identify piping at the following locations:

.1 At each valve.

.2 On both sides of wall penetrations.

.3 At floor and roof penetrations.

.4 On each leg of branches.

.5 Every 15 m along continuous runs.

END OF SECTION

EXTERIOR SIGNAGE

1. GENERAL

1.1 Shop Drawings

.1 Submit Shop Drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Indicate materials, colours, font style, font size, and anchorage details.

1.2 Maintenance Data

.1 Provide operation and maintenance data for signage cleaning for incorporation into maintenance manual specified in Section 01 78 00 – Closeout Submittals.

2. PRODUCTS

2.1 Materials

.1 4.8 mm Sheet Aluminum.

.2 Baked enamel border and background.

.3 Printed Letters.

.4 Clear Coat with two (2) coats of clear acrylic polyurethane.

.5 Mounting: nominal 13 mm deep clear anodized aluminum stand off studs secured to field painted, galvanized unitstrut.

.6 Colours: From manufacturer's standard pigment colours. Contract Administrator will provide a reduced sized, coloured logo sample in order to match signage colours and specific City logo images and fonts.

.7 Fasteners: Non-magnetic, stain and corrosion resistant stainless steel to A304.

2.2 Fabrication

.1 Fabricate in order to maximize the aesthetic visual appearance of the signage. The Contract Administrator will be judge of the acceptable appearance of the signage.

3. EXECUTION

3.1 Installation

.1 Install signage utilizing stainless steel anchors.

.2 Install items plumb, square, and level, fitted accurately and maintain free from distortion or defects detrimental to appearance and performance.

.3 Isolate metals where necessary to prevent corrosion due to contact between dissimilar metals.

.4 Coordinate signage location with Contract Administrator.

END OF SECTION

INTERIOR SIGNAGE

1. GENERAL

1.1 Shop Drawings

.1 Submit Shop Drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Indicate materials, logo details and images, colours, font style, font size, and anchorage details.

1.2 Maintenance Data

.1 Provide operation and maintenance data for signage cleaning for incorporation into maintenance manual specified in Section 01 78 00 – Closeout Submittals.

2. PRODUCTS

2.1 Materials

.1 4.8 mm Sheet Aluminum.

.2 Baked enamel border and background.

.3 Printed Letters.

.4 Clear Coat with two (2) coats of clear acrylic polyurethane.

.5 Colours: Unlimited, custom colours. Contract Administrator will provide a reduced sized, coloured logo sample in order to match signage colours and specific City logo images and fonts.

.6 Fasteners: Non-magnetic, stain and corrosion resistant stainless steel to A304.

2.2 Fabrication

.1 Fabricate in order to maximize the aesthetic visual appearance of the signage. The Contract Administrator will be judge of the acceptable appearance of the signage.

.2 Seal all edges and back of the base signage plywood material.

3. EXECUTION

3.1 Installation

.1 Install signage utilizing stainless steel anchors.

.2 Install signage level.

.3 Coordinate signage location with Contract Administrator.

END OF SECTION

1. GENERAL

1.1 General Requirements

.1 For additional information, refer to Division 1 - General Conditions of the Construction Contract.

.2 The Construction Contractor shall be responsible for coordinating all aspects of this work with all construction drawings and specifications. The Construction Contractor will confirm in writing that all contract documents have been fully coordinated.

.3 Provide complete, fully tested and operational mechanical systems to meet the requirements described herein and in complete accordance with current edition of applicable codes and ordinances.

.4 Construction Contract Documents and Drawings pertinent to the mechanical works are diagrammatic and are approximately to scale unless detailed otherwise. They establish design intent, scope, material and installation quality and are not detailed installation instructions. Locations of equipment, ductwork, pipework, and all associated appurtenances indicated on the Drawings are approximate only. The Construction Contractor is responsible for checking and coordinating the locations of equipment, ductwork, pipework, and all associated appurtenances and shall make any necessary adjustments in positions to conform with the architectural features, other services, symmetry and lighting arrangements.

.5 Follow manufacturers' recommended installation details and procedures for equipment, supplemented by requirements of Construction Contract Documents.

.6 Install equipment generally in locations and routes shown. Run piping and ductwork close to building structure, parallel to building lines to maximize headroom and with minimum interference with other services and free space. Remove and replace improperly installed equipment to satisfaction of the Contract Administrator at no extra cost.

.7 Install equipment to provide access and ease of maintenance.

.8 Connect to equipment specified in other Sections and to equipment supplied and installed by other division within contract. Uncrate equipment, move in place and install complete; start-up, test, and correct any deficiencies.

.9 Install control valves, control dampers, thermal wells, and other devices on piping and ducts, furnished by controls contractor.

.10 Furnish a written guarantee stating that all work executed in this Construction Contract will be free from defective workmanship and materials for a period of one (1) year from the date of Substantial Performance. The Construction Contractor shall, at his own expense, repair and replace any work which fails or becomes defective during the term of the guarantee/warranty, providing such work is not due to improper usage. The period of guarantee specified shall not in any way supplant any other guarantees of a longer period but shall be binding on work not otherwise covered.

.11 If the equipment is used during construction, the guarantee or guarantee period shall not be shortened or altered.

1.2 Coordination of Work

.1 Cooperate and coordinate with other trades on the project.

.2 Make reference to electrical, mechanical, process, controls, structural, and architectural drawings when setting out work. Consult with all other trades in setting out locations for ductwork, equipment, and piping, so that conflicts are avoided and symmetrical even spacing is maintained. Jointly work out all conflicts on site before fabricating or installing any materials or equipment.

.3 Where dimensional details are required, work with the applicable architectural and structural drawings and field measurements as required.

.4 Full-size and detailed drawings shall take precedence over scale measurements from drawings.

.5 Any areas indicated as space for future materials or equipment shall be left clear.

1.3 Permits

.1 All Work shall comply with provincial, municipal, by-laws and Authorities Having Jurisdiction.

.2 Obtain all permits and pay all fees applicable to the Work.

.3 Construction Contractor shall arrange for inspections of the Work by the Authorities Having Jurisdiction and shall provide certificates indicating final approval.

1.4 Award of Construction Contract

.1 Submit a detailed price breakdown within thirty (30) days of award of Construction Contract and before first progress claim, in a format agreed to with the Contract Administrator.

.2 As a minimum, include the following in the detailed price breakdown:

.1 Site Services: materials, labour.

.2 Mechanical: equipment, materials, labour.

.3 Plumbing: equipment, materials, labour.

.4 Sheet Metal: equipment, materials, labour.

.5 Fire protection: equipment, materials, labour.

.6 Controls: equipment, materials, labour.

1.5 Progress Claims

.1 Submit a Progress Summary and a detailed price breakdown with each progress claim. The Summary and Breakdown shall include all Change Orders issued.

.2 Progress claims shall not be processed past 95% of the overall Construction Contract until the final commissioning has been completed. This will allow for sufficient deficiency holdbacks for problems identified during commissioning.

1.6 Quality of Work

.1 All Work shall be performed by qualified tradesmen with valid Provincial Trade Qualification Certificates. Spot checks will be made by the Contract Administrator.

.2 Work which does not conform to standards accepted by the Contract Administrator and Authority Having Jurisdiction (AHJ) may be rejected by the Contract Administrator. The Construction Contractor shall redo rejected work to the accepted standard at no cost to the City.

1.7 References

.1 Except as specified, the latest edition of the standards listed within each Section form a part of this Specification to the extent referenced within each Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

.2 In each of the standards referred, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

1.8 Metric Conversion

.1 All units in this division are expressed in SI units.

.2 Equivalent Nominal Diameters of Pipes - Metric and Imperial:

.1 When CSA approved SI metric pipes are provided, the Construction Contractor shall provide at no extra cost adapters to ensure compatible connections between the SI metric pipes and all new and existing pipes, fittings, and equipment.

mm (in. NPS)	mm (in. NPS)	mm (in. NPS)
3 (1/8)	65 (2½)	450 (18)
6 (1/4)	75 (3)	500 (20)
10 (3/8)	100 (4)	600 (24)
15 (1/2)	125 (5)	750 (30)
20 (3/4)	150 (6)	
25 (1)	200 (8)	
30 (1¼)	250 (10)	
40 (1½)	300 (12)	
50 (2)	375 (15)	

.3 Metric Duct Sizes:

.1 The metric duct sizes are expressed as 25 mm = 1 inch.

1.9 Alternative Materials and Equipment

.1 The price submitted for this Construction Contract shall be based on the use of materials and equipment as specified or as contained within the Acceptable Manufacturers List.

.2 The Construction Contractor may request substitutions if they believe that such substitutions will not impact functionality. Such requests must include a description of why the substitution

is equal or better than the original requirement. Where such substitutions require an engineering change, the Construction Contractor shall engage a Professional Engineer registered in the Province of Manitoba to sign and seal the request. Time spent reviewing requests for substitutions whether approved or not, will be charged to the Construction Contractor and deducted from the Construction Contractor's next progress claim.

.3 Requests for approval shall be submitted to the Contract Administrator, complete with all applicable technical data, including performance curves and physical details, and highlighting all areas indicating conformance with the material, technical and performance specification. The Construction Contractor shall submit all requests in the same SI units stated in the Construction Contract Documents, or with converted values where SI units are not available. Submit original pdf files or original printed documents. Photocopied, faxed, or scanned documents or documents submitted in imperial units will not be reviewed.

.4 Approved equivalents and/or alternatives to specified products shall be equal to the specified product in every respect, operate as intended, meet the space, capacity, and noise requirements outlined.

.5 The Construction Contractor shall be fully responsible for any additional work or materials required by the trades or other contractors to accommodate use of other than specified materials or equipment. Extras will not be approved to cover such work.

1.10 Action and Informational Submittals

.1 Comply generally with Section 01 33 00 - Submittal Procedures, for submission requirements, as well as the requirements contained herein.

.2 Provide one (1) electronic copy or two (2) printed copies, for all scheduled equipment and as specified in specific equipment sections of this Specification. Submit electronic copies in pdf format using original documents or create the pdf. Scanned copies shall be rejected. For printed submittals, submit original printed documents. Photocopied or faxed documents will be rejected.

.3 Submit all Shop Drawings and maintenance manuals in SI units. On all Shop Drawings use the same SI units as stated in the Specification or in the schedules or both. Where information is not produced in the same SI units as stated in the Specification or in the schedules or both, the Construction Contractor will provide converted values. Shop Drawings not presented in the same SI units as stated in the Specification or in the schedules or both or without converted values will be rejected.

.4 Clearly mark each Shop Drawing with the Specification Section number together with the clause number or schedule number and the item tag number (where applicable) to which it refers. Failure to include this information on Shop Drawings will result in the drawings being rejected.

.5 Identify materials and equipment by manufacturer, trade name and model number. Include copies of applicable brochure or catalogue material. Do not assume applicable catalogues are available in the Contract Administrator's office. Maintenance and operating manuals are not suitable submittal material.

.6 Clearly mark submittal material using arrows, underlining or circling to show differences from specified, e.g. ratings, capacities and options being proposed. Cross out non-applicable material. Specifically note on the submittal specified features such as special tank linings, pumps seals materials or painting.

.7 Include weight, dimensional, and technical data sufficient to check if equipment meets requirements. Include wiring, piping, and service connection data and motor sizes.

.8 Installed materials and equipment shall meet specified requirements regardless of whether or not Shop Drawings are reviewed by the Contract Administrator.

.9 Do not order equipment or material until the Contract Administrator has reviewed and returned Shop Drawings.

.10 Prior to submission to the Contract Administrator, the Construction Contractor shall review all Shop Drawings. By this review, the Construction Contractor certifies that he has determined and verified all field measurements, field construction criteria, materials, catalogue numbers and similar data, and certifies that he has checked and coordinated each Shop Drawing with the requirements of the work of the Construction Contract Documents. The Construction Contractor's review of each Shop Drawing shall be indicated by stamp, date and signature of the Construction Contractor's designated project manager.

.11 Retain one (1) copy of Shop Drawings on site for review.

1.11 Closeout Submittals

.1 Refer to Section 01 33 00 - Submittal Procedures, and Section 01 78 00 - Closeout Submittals for submission requirements.

.1 Closeout Submittals:

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

.2 Operation and maintenance manual approved by, and final copies deposited with, Contract Administrator before final inspection.

.2 Operation data to include:

.1 Control schematics for systems including environmental controls.

.2 Description of systems and their controls.

.3 Description of operation of systems at various loads together with reset schedules and seasonal variances.

.4 Operation instruction for systems and component.

.5 Description of actions to be taken in event of equipment failure.

.6 Valves schedule and flow diagram.

.7 Colour coding chart.

.3 Maintenance data to include:

.1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.

.2 Data to include schedules of tasks, frequency, tools required and task time.

.4 Performance data to include:

.1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.

.2 Equipment performance verification test results.

.3 Special performance data as specified.

.4 Testing, adjusting and balancing reports as specified in Section 23 05 93.20 - Testing, Adjusting and Balancing for HVAC.

.5 Review:

.1 Submit one (1) copy of the draft Operation and Maintenance Manual to Contract Administrator for review. Submission of individual data will not be accepted unless directed by Contract Administrator.

.2 Make changes as required and re-submit as directed by Contract Administrator.

.6 Additional data:

.1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.

.7 Site records:

.1 Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur.

.2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.

.3 Use different colour waterproof ink for each service.

.4 Make available for reference purposes and inspection.

.8 As-built Drawings:

.1 Prior to start of Testing, Adjusting and Balancing (TAB), finalize production of As-built Drawings.

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

.3 Submit to Contract Administrator for review and make corrections as directed.

.4 Perform testing, adjusting and balancing for HVAC using As-built Drawings.

.5 Submit completed reproducible As-built Drawings with Operating and Maintenance Manuals.

.9 Submit copies of As-built Drawings for inclusion in final TAB report.

1.12 Maintenance

.1 Furnish spare parts in accordance with Section 01 78 00 - Closeout Submittals as follows:

.1 One (1) set of packing for each pump.

.2 One (1) glass for each gauge glass.

.3 One (1) filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.

.4 Provide one (1) set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00 - Closeout Submittals.

.5 Furnish one (1) commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.13 Delivery, Storage and Handling

.1 Shipping:

.1 All equipment, material and spare parts shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability, or appearance. Equipment and material warranties shall not be voided by actions of the Construction Contractor.

.2 Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

.3 Pack spare parts in containers bearing labels clearly designated contents and pieces of equipment for which intended.

.4 Deliver spare parts at same time as pertaining equipment. Deliver to the City after completion of Work.

.2 Receiving:

.1 All equipment, material and spare parts shall be delivered to the Site in original packages or containers bearing the manufacturer's labels and product identification.

.2 Inspect for damage and correctness, and inventory items, upon delivery to Site.

.3 Store equipment, material and spare parts protected for the weather, humidity and temperature variations, dirt and dust or other contaminants. Store and safeguard in accordance with manufacturer's recommendations.

1.14 Salvage

.1 Remove from site all equipment, ducting or piping which is no longer required because of work under this Construction Contract.

.2 Turnover to and deliver to the City's storage area all items which have been determined to have salvage value and has been removed due to the Work.

1.15 Cutting, Patching and Coring

.1 Provide holes and sleeves, cutting and fitting required for mechanical work.

.2 Drill for expansion bolts, hanger rods, brackets, and supports.

.3 Obtain written approval from the Contract Administrator before cutting or burning structural members.

.4 Provide openings and holes required in precast members for mechanical work. Cast holes 100 mm or larger in diameter. Field-cut smaller than 100 mm. No torch cut holes.

.5 Patch building where damaged from equipment installation, improperly located holes etc. Use matching materials as specified in the respective section.

1.16 Outdoor Piping Sealant

.1 Unless otherwise noted, all outdoor openings around pipe penetrations shall have the gap filled with an adhesive/sealant to provide a weatherproof seal.

.2 Adhesive/sealant shall be polyurethane based, temperature range of minus 40°C to 93°C, paintable with the use of primer, sandable, and have high UV resistance.

.1 Acceptable adhesive/sealant: Silaprene Solid Seal from Faucher Industries (Model: 642-2263, Grey).

1.17 Installation of Equipment

.1 Pipe all equipment drains to building drains. Drain lines to be routed in neat manner, sloped to ensure proper drainage, and routed to avoid being a safety hazard.

.2 Unions and flanges shall be provided in piping or ductwork to permit easy removal of equipment.

.3 Maintain permanent access to equipment for maintenance.

1.18 Acceptable Manufacturers/Supplier and Agencies

.1 The following listed manufacturers are acceptable for their ability to meet the general design intent, quality and performance characteristics of the specified product. The list does not endorse the acceptability of all products available from the listed manufacturers/suppliers.

.2 It remains the responsibility of the Construction Contractor to ensure the products supplied are equal to the specified products in every respect, operate as intended, and meet the performance specifications and physical dimensions of the specified product.

.3 The Construction Contractor shall be fully responsible for any additional work or materials, to accommodate the use of equipment from the acceptable manufacturers and suppliers list.

.4 Submit within fourteen (14) days of Construction Contract award a copy of the list underlining the name of the manufacturer whose price was carried in the Tender. If no manufacturer's names are submitted, it will be assumed that the price carried in the Tender was that of the specified manufacturer or where the specified product is generic, the first acceptable manufacturer listed for each item and equipment.

.5 List of Acceptable Manufacturers/Suppliers and Agencies:

.1	Access Doors	Maxam, Acudor, Milcor, Can.Aqua, Mifab, The Williams Brothers Corporation
.2	Actuators	Belimo, Honeywell, JCI, Rotork, Siemens
.3	Air Flow Measuring Air Monitor, Air Stations	Cambridge, Sentinel, Ebtron, Air Monitor Corporation, PCI, Ebtron
.4	Air Handling Units - Indoor or Outdoor Pre-manufactured	Trane, Engineered Air, McQuay, Haakon, Scott Springfield
.5	Air Separators, Relief Valves	Armstrong, Bell & Gossett, Taco, Wheatley
.6	Air to Air Energy Recovery Ventilators	Engineered Air, Tempeff, Solution Air
.7	Air Terminals - Grilles Registers, Diffusers	E.H. Price, Titus, Anemostat, Nailor
.8	Air Vents	Hoffman, Maid-O-Mist, Taco
.9	Backflow Preventers	Febco, Watts, Hersey, Singer, Ames
.10	Balancing Agents	AMS, AHS, DFC, Airdronics
.11	Bypass Filter (HW)	Sumco, GESL, Pace Chemicals
.12	Coils - Heating and Cooling	Trane, Engineered Air, Daikin, Carrier, York
.13	Condensers - Air Cooled Refrigerant	Trane, Carrier, Engineered Air, Keeprite
.14	Controls Contractors and/or Suppliers	Barber Coleman, Barcol, Delta, Honeywell, Johnson Controls, Siemens
.15	Convectors - HW	Engineered Air, Trane, Rosemex, McQuay, Dunham Bush
.16	Couplings (building sanitary to municipal sewer system)	Romac", "Robar", "Smith-Blair Inc.", "Mueller Viking Johnson Couplings
.17	Dampers - Actuators	Belimo, Honeywell, Siemens, JCI, Rotork

.18	Dampers - Backdraft	Airolite, Vent-Aire, Penn, T.A. Morrison
.19	Dampers - Balancing	Price, Nailor, Maxam, Ruskin
.20	Dampers - Control	Price, Nailor, Ruskin, Tamco
.21	Dampers - Smoke-Fire Combination	Ruskin, Controlled Air, Prefco
.22	Diffusers, Registers, Grilles	Price, Nailor, Titus
.23	Domestic Water Heaters - Electric	Aerco, AO Smith, Bradford White, Jetglas, Ruud-Rheem, State
.24	Drains - Floor, Roof, Cleanouts Trap Primers, Water Hammer Arrestors	Zurn, Ancon, PPP, J.R. Smith
.25	Expansion Compensators	Flexonics, Tube Turn, Hyspan, Hydroflex, Metraflex, United Flexible, Mason
.26	Expansion Joints	Flexonics, Hyspan, Hydroflex, Metraflex, United Flexible, Mason
.27	Emergency Eye Wash Fountains, Showers	Bradley, Haws, Western
.28	Fans - Roof and Wall Mounted	Greenheck, Ammerman, Powerline, ACME, Loren Cook, Penn, Jenn Fan, ILG, Carnes, Twin City
.29	Filters	Cambridge, AAF, Pacific, FARR
.30	Filters (Final)	FARR Durafil ES
.31	Fire Dampers	Controlled Air, Ruskin, Canadian Advanced Air, Maxam, Nailor
.32	Fire Hose Cabinets, Valves and Extinguishers	NFE, Grigor, Wilson & Cousins, Flag
.33	Flexible Connectors - Ducting	Thermaflex, G.I. Industries Type IHP
.34	Flexible Connectors - Piping	Flexonics, Tube Turn, Atlantic, Hyspan, Hydroflex, Metraflex, United Flexible, Mason
.35	Gauges - Air	Dwyer, Magnehelic
.36	Gauges - OWG Pressure	Trerice, Marsh, Ashcroft, Weiss
.37	Heat Exchangers - Plate	Bell & Gossett, Alpha Laval, Tranter, Armstrong, APV
.38	Hose Bibbs	Jenkins, Dahl, Crane, Toyo, Kitz, Mifab

.39	Insulation - Piping and Duct	Fibreglass Canada, Manson, Knauf Fibreglass, Plasti-Fab, Manville
.40	Louvers	Price/Airolite, Penn, Airstream, West Vent, Nailor, Ruskin, Ventex, Titus
.41	Makeup Air Units - Packaged	Engineered Air, McQuay, Reznor
.42	Pipe Restraints	Trelleborg
.43	Piping Hangers and Saddles	Anvil, Myatt
.44	Plumbing Brass	Crane, American Standard, Cambridge Brass, Waltec, Kohler, Symmons
.45	Plumbing Fixtures	Crane, American Standard, Kohler
.46	Plumbing Fixtures - Prefab FRP	Aquarius, Acrylic Tubs
.47	Plumbing: Floor Drains, Roof Drains, Hose Bibbs	Mifab, Zurn, Smith
.48	Pressure Gauge/Transmitter (Explosion Proof)	Rosemount
.49	Pressure Gauge/Transmitter (Filter)	Dwyer, Ashcroft
.50	Pumps - In-Line Circulators	Armstrong, B & G, Taco, Grundfos
.51	Pumps - Vertical In-Line and Base Mounted	Armstrong, B & G, Taco, Leitch, Grundfos
.52	Radiation - Wall Fin	Engineered Air, Trane, Slant/Fin, Rosemex, Dunham Bush, Rittling
.53	Sinks - Mop	Fiat, Crane, American Standard
.54	Sinks - Stainless Steel	KIL, American Standard, Elkay
.55	Strainers	Armstrong, Sarco, Mueller, Toyo, Anderson, Metraflex, Yarway
.56	Tank – Diaphragm/Bladder Type Expansion	Amtrol, Hamlet and Garneau Inc.
.57	Temperature Sensors (Thermostats, Room, Duct)	Honeywell, JCI
.58	Thermometers	Trerice, Marsh, Ashcroft, Winters
.59	Unit Heaters - Cabinet	Rittling, Trane, Engineered Air, Rosemex, Daikin
.60	Unit Heaters - Electric	Ouellet, Chromalox, Q-Mark

.61	Unit Heaters - HW	Engineered Air, Trane, Rosemex, Daikin, Rittling,
.62	Valves - Actuators	Belimo, Honeywell, Siemens, JCI
.63	Valves - Butterfly	Jenkins, Keystone, DeZurik, Centreline, Monotight, Dresser, Lunkenheimer, Crane, Bray, Toyo, Grinnell
.64	Valves - Circuit Balancing	Armstrong, B & G, Wheatley, Tour & Anderson
.65	Valves - Drain, Radiator	Jenkins, Dahl, Crane, Toyo, Kitz
.66	Valves - Eccentric Plug	DeZurik, Homestead
.67	Valves - Gate, Globe, Swing, Check, Ball	Jenkins, Toyo, Crane, Kitz, Milwaukee
.68	Valves - Plumbing Flush	Crane, Sloan, Teck
.69	Valves - Pressure Balanced Mixing	Symmons
.70	Valves - Pressure Reducing	Armstrong, Bell & Gossett, Taco
.71	Valves - Relief	Armstrong, Bell & Gossett, Taco, Wheatley
.72	Valves - Suction Diffusers Combination Check and Balance	Armstrong, B&G, Taco
.73	Valves - Thermostatic Mixing	Lawler, Leonard, Powers, Symmons
.74	Valves - Water Pressure Reducing	Watts, Clayton, Singer, Zurn. Wilkins, BCA, Cash Acme, Braukman
.75	Vent Caps	Jenn-Air, Penn Ventilator
.76	Vibration Isolation	Mason, Vibro Acoustic

1.19 Firestopping

.1 Firestop all pipe, duct, conduit and wire penetrations through floors and walls, designated as fire and/or smoke separations. The Construction Contractor is required to coordinate with the architectural drawings to contractual rated wall types and installation details.

.2 Firestopping materials. Acceptable Materials: "Tremco" or "National Firestopping", or Hilti CP680 Cast-in-Place Firestopping System.

.3 Preparation of surfaces and installation of firestopping materials shall be carried out as per manufacturer's instructions.

1.20 Connections to Existing Services

.1 Maintain liaison with the City and provide a schedule to interrupt, re-route or connect to water, sewer, heating, or gas systems, with minimum interruption of services.

.2 Major services shall not be interrupted before all preparatory work is completed and all required materials are on site. Provide a minimum of five (5) working days written notice for all service shutdown.

.3 Interruptions and shutdowns of existing services shall be by the building/plant maintenance staff.

1.21 Equipment and Materials

.1 Materials and equipment installed shall be new, full weight and of quality specified.

.2 Each major component of equipment shall bear manufacturer's name, address, catalogue and serial number in a conspicuous place.

.3 Where two (2) or more products of the same type are required, products shall be of the same manufacturer.

.4 Make known in writing to the Contract Administrator ten (10) days prior to the award of Construction Contract any materials specified that are required to complete the work which are not currently available or will not be available for use as called for herein. Failing to do so, it will be assumed that the most expensive alternate has been included in the Construction Contract price.

1.22 Equipment Protection and Clean-Up

.1 Protect equipment and materials in storage on site during and after installation until final acceptance. Leave factory covers in place. Take special precautions to prevent entry of foreign material into working parts of piping and duct systems.

.2 Protect equipment with polyethylene covers and crates.

.3 At no cost to the Construction Contract, the Construction Contractor shall repair and/or replace, to the Contract Administrator's satisfaction, any installed equipment or material which is deemed by the Contract Administrator to be damaged.

.4 Operate, drain and flush out unsealed bearings and refill with new change of oil, before final acceptance.

.5 Thoroughly clean piping, ducts and equipment of dirt, cuttings and other foreign substances.

.6 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install necessary extended nipples for lubrication purposes.

.7 Ensure that existing equipment is carefully dismantled and not damaged or lost. Do not reuse existing materials and equipment unless specifically directed to do so by the Contract Administrator.

1.23 Electrical Motors

.1 Supply mechanical equipment complete with electrical motors.

.2 Provide motors designed, manufactured, and tested in accordance with the latest edition of all applicable codes and standards: All motors to be CSA labelled. All motors to be approved for use in the designated area classification by the Provincial Electrical Protection Branch.

.3 All motors intended for use with a variable speed drive (variable frequency drive) shall be inverter only rated. Variable speed drive shall be matched to motor.

.4 Two speed motors shall have separate winding for each speed.

.5 Unless specified otherwise, provide motors designed for full voltage starting, NEMA Design B. Motors driving high torque or high inertia loads may be NEMA Design C or D.

.6 Provide motors rated for continuous duty with 1.15 service factor unless specified otherwise in the driven equipment specifications. Provide all motors with thermal overload protection.

.7 Motors less than 0.38 kW shall be 120 V, 60 Hz, 1 phase. Motors 0.38 kW and larger shall be 3 phase at the indicated voltage.

.8 All motors shall be 1800 rpm except where indicated in Drawings and/or Specifications.

.9 Provide motors with grease or oil lubricated anti-friction type ball or roller bearings.

.10 Provide motors designed with Class B insulation; Class F insulation for totally enclosed motors.

.11 Where motor power is stated in watts or kilowatts, nominal motor horsepower multiplied by 746 or 0.746 respectively, has been used as the conversion factor.

1.24 Miscellaneous Metals

.1 Provide all necessary miscellaneous metals to hang or support materials, equipment and provide access for work under this Construction Contract.

.2 All miscellaneous metals shall be primed and painted as per Section 09 91 00 - Painting.

.3 Miscellaneous metals shall include but are not limited to:

.1 Hangers for equipment, piping and ductwork.

.2 Support for equipment.

.3 Access platforms and catwalks.

1.25 Escutcheon and Plates

.1 Provide escutcheon and plates on piping and ductwork passing through finished walls, floors and ceilings.

.2 Escutcheons shall be the splitless type, stainless or chrome plated steel.

1.26 Temporary or Trial Usage

.1 Temporary or trial usage by the City or Contract Administrator of mechanical equipment supplied under Construction Contract shall not represent acceptance.

.2 Repair or replace permanent equipment used temporarily.

.3 Repair or otherwise rectify damage caused by defective materials or workmanship during temporary or trial usage.

1.27 Substantial Performance and Final Completion

.1 Progress payments beyond 95% will not be considered unless:

.1 Water heating and hot water systems have been commissioned and are capable of operation with alarm controls functional and automatic controls in operation at rated performance. Commissioning checklists must be submitted prior to the request by the Construction Contractor to have a Substantial Performance inspection.

.2 The necessary tests on equipment and systems including those required by authorities have been completed with certificates of approval.

.3 Air and water systems have been balanced and draft report submitted to the Contract Administrator.

.4 Valve tagging and equipment identification is complete.

.5 Warranty forms have been mailed to the manufacturer. Provide copy of original warranty for equipment, which has warranty period longer than one (1) year.

.6 Systems have been chemically cleaned. Flush and initiate water treatment. Provide report from manufacturer's representative to confirm status of treatment.

.7 Draft Operating/Maintenance Manuals have been submitted.

.8 Operating and Maintenance demonstrations have been provided to the City.

.9 Written inspection report has been submitted by manufacturer’s representative for noise and vibration control devices and flexible connections.

.10 As-built Drawings have been submitted.

.11 Fan plenums have been cleaned, and temporary filters have been replaced with permanent filters.

.12 All previously identified deficiencies have been corrected.

.2 The following shall be an outline checklist of the minimum requirements to be met by the Construction Contractor prior to the Construction Contractor requesting an inspection for final deficiency by the Contract Administrator. In addition to the checklist the Construction Contractor shall provide a list of items known prior to inspection to have been identified as deficient and still to be rectified to the Contract Administrator’s satisfaction.

.1 Complete Commissioning Checklists.

.2 Final Plumbing Inspection Certificate from local plumbing inspector.

.3 Final Backflow Prevention test reports for all backflow devices.

.4 Controls Commissioning, Checklist and fifteen (15) day trend logs for all major equipment (AHUs, Chiller/Boiler Plants, selected space sensors).

.5 Vibration isolation supplier's inspection report.

.6 Chemical Treatment supplies final inspection and test certificate.

.7 Potable water mains flushing and chlorination test certificate.

.8 Sound level tests reports (as required).

.9 Major equipment – suppliers start-up test sheets and letters certifying start-up (boilers, chillers, packaged equipment).

.10 Final As-Built Drawings ready for review.

.11 Maintenance and operation manuals, ready for review.

.3 Prior to Final Inspection provide declaration in writing that deficiencies noted at time of inspection for final deficiencies have been corrected and the following items completed prior to the final completion inspection:

.1 Submit final air and water balance reports.

.2 Submit final operating and maintenance manuals.

.3 Complete final calibration.

.4 The Contract Administrator shall provide one (1) visit for Final Inspection. Subsequent visits if required shall be at the expense of the Construction Contractor.

.5 The Construction Contractor shall provide qualified personnel in appropriate numbers to operate the facility until Substantial Performance is declared.

1.28 Related Work in Other Sections

.1 Refer to other Specification Sections to complete list of equipment supplied by other Division within Contract.

1.29 Installation

.1 Make all mechanical connections to equipment supplied by other division within contract and Novated Equipment. This shall include all water, drain, gas, exhaust, traps, ductwork and similar connections required. Provide isolation valves, unions, flanges and traps as required for a complete installation.

.2 Change to rough-in of services or final equipment connections due to a change in the make of equipment from that specified shall be made at no extra cost to the City, provided that proper Shop Drawings are available for rough-in. Prior to commencing installation of rough-in for the equipment, coordinate with the final reviewed equipment Shop Drawings and with the manufacturer.

.3 Arrange piping connections to allow for equipment removal.

2. PRODUCTS (NOT USED)

3. EXECUTION

3.1 Painting Repairs and Restoration

.1 Do painting in accordance with Section 09 91 00 - Painting.

.2 Prime and touch-up marred finished paintwork to match original.

.3 Restore to new condition, finishes which have been damaged.

3.2 Cleaning

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

3.3 Protection

.1 Protect equipment and systems openings from dirt, dust, and other foreign materials.

END OF SECTION

PORTABLE FIRE EXTINGUISHERS

1. GENERAL

1.1 Related Requirements

.1 Section 21 05 01 – Common Work Results for Mechanical.

1.2 References

.1 Fire Commissioner of Canada (FC).

.2 National Fire Prevention Association (NFPA):

.1 NFPA 10, Standard for Portable Fire Extinguishers.

1.3 Action and Informational Submittals

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for fire extinguishers and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 Closeout Submittals

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

.2 Operation and Maintenance Data: submit operation and maintenance data for portable fire extinguishers for incorporation into manual.

1.5 Delivery, Storage and Handling

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

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

.3 Storage and Handling Requirements:

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

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

.3 Replace defective or damaged materials with new.

2. PRODUCTS

2.1 Portable Hand Fire Extinguishers

.1 General areas:

.1 Multi-Purpose Dry Chemical Pressurised extinguisher with hose and shut-off nozzle or integral shut-off nozzle.

.2 Wall mounting hook/bracket.

.3 Rating minimum:

.1 3A:40BC

.2 Electrical rooms:

.1 Carbon dioxide type extinguisher with rustproof aluminum cylinder, horn nozzle.

.2 Wall mounting hook/bracket.

.3 Rating minimum:

.1 10BC

3. EXECUTION

3.1 Installation

.1 Install extinguishers so that the bottom of extinguisher is between 900 mm (3 ft) and 1200 mm (4 ft) above floor.

END OF SECTION

PLUMBING PUMPS

1. GENERAL

1.1 Description

.1 For additional information, refer to Section 21 05 01 - Common Work Results for Mechanical and Division 1 - General Conditions of the Construction Contract.

.2 For a list of applicable codes and standards, refer to Section 21 05 01 - Common Work Results for Mechanical.

.3 The Construction Contractor shall be responsible for coordinating all aspects of this Work.

.4 Locations of equipment, ductwork, pipework, and all associated appurtenances indicated on the Drawings are approximate only. The Construction Contractor is responsible for checking and coordinating the locations of equipment, ductwork, pipework, and all associated appurtenances and shall make any necessary adjustments in positions to conform with the architectural features, other services, symmetry and lighting arrangements.

1.2 Scope of Work

.1 The Scope of Work for this Section includes, but is not limited to, the following:

.1 Materials and procedures for the provision and installation of pumping equipment for plumbing systems.

1.3 Related Work

.1 This Section may not contain all materials, equipment and requirements required for the completion of this project. This Section is to be read in conjunction with the remaining Sections of Division 21, 22 and 23 any and all related works.

.2 Division 1 forms an integral part of Divisions 21, 22 and 23.

1.4 References

.1 Except as specified herein, the latest edition of the standard.

.2 Standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

.3 In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

.1 Material Safety Data Sheets (MSDS).

.5 National Research Council (NRC)/Institute for Research in Construction:

.1 NRCC 38728, National Plumbing Code of Canada (NPC) as amended by Manitoba plumbing code.

1.5 Action and Informational Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical and Section 01 33 00 - Submittal Procedures for submission requirements.

.2 Product Data: Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Submit copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

1.6 Closeout Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical, Section 01 33 00 - Submittal Procedures, and Section 01 78 00 - Closeout Submittals for submission requirements.

1.7 Delivery, Storage and Handling

.1 Shipping:

.1 All equipment, material and spare parts shall be shipped, stored, handled, and installed in such a manner as not to degrade quality, serviceability, or appearance. Equipment and material warranties shall not be voided by actions of the Construction Contractor.

.2 Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

.3 Pack spare parts in containers bearing labels clearly designated contents and pieces of equipment for which intended.

.4 Deliver spare parts at same time as pertaining equipment. Deliver to City after completion of Work.

.2 Receiving:

.1 All equipment, material and spare parts shall be delivered to the Site in original packages or containers bearing the manufacturer's labels and product identification.

.2 Inspect for damage and correctness, and inventory items, upon delivery to Site.

.3 Store equipment, material and spare parts protected for the weather, humidity and temperature variations, dirt and dust or other contaminants. Store and safeguard in accordance with Manufacturer's recommendations.

1.8 Quality Assurance

.1 Performance Requirements:

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

2. PRODUCTS

2.1 Domestic Hot Water Circulating Pump

.1 Casing: Stainless steel rated for 860 kPa working pressure.

.2 NPT Union connections.

.3 Impeller: Noryl.

.4 Shaft: Ceramic.

.5 Bearings: Ceramic.

.6 Gasket: EPDM.

.7 Motor: 115 V, 1-ph, 60 Hz, drip-proof, with thermal overload protection.

.8 Multiple speed settings.

.9 Supports: provide as recommended by manufacturer.

.10 Refer to Equipment Schedules for specific selections.

.11 See Equipment Schedules for pump performance characteristics.

2.2 Scale Pit – Submersible Grinder Pump

.1 The submersible pump shall be capable of handling residential sewage and grinding it to a fine slurry, enabling it to be pumped over long distances.

.2 Rated for Class I, Division 1, Groups C & D and Class 1, Zone 1, Groups IIA & IIB.

.3 Casing: Cast iron.

.4 Discharge size: 32mm (1.25”) NPT.

.5 Impeller: Ductile iron, Non-clogging vortex type.

.6 Shaft: stainless steel.

.7 Seal: Carbon/ceramic with stainless steel parts.

.8 Motor: Oil filled, capacitor start / run, class B insulated NEMA B design, with thermal overload protection/thermal sensor.

.9 Fasteners: All fasteners exposed to the liquid shall be stainless steel.

.10 Cutter mechanism: stainless steel with a Rockwell C hardness of at least 55.

.11 Acceptable product:

.1 Zoeller Explosion Proof Series Grinder Pumps.

.12 See Equipment Schedules for pump performance and motor characteristics.

3. EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Make piping and electrical connections to pump and motor assembly and controls as indicated.

.2 Ensure pump and motor assembly do not support piping.

3.3 Cleaning

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1. GENERAL

1.1 Description

.1 For additional information, refer to Section 21 05 01 - Common Work Results for Mechanical and Division 1 - General Conditions of the Construction Contract.

.2 For a list of applicable codes and standards, refer to Section 21 05 01 - Common Work Results for Mechanical.

.3 The Construction Contractor shall be responsible for coordinating all aspects of this Work.

.4 Locations of equipment, ductwork, pipework, and all associated appurtenances indicated on the Drawings are approximate only. The Construction Contractor is responsible for checking and coordinating the locations of equipment, ductwork, pipework, and all associated appurtenances and shall make any necessary adjustments in positions to conform with the architectural features, other services, symmetry, clearances, and lighting arrangements.

1.2 Scope of Work

.1 The Scope of Work for this Section includes, but is not limited to, the following:

.1 Materials and procedures for the provision and installation of process and domestic hot and cold water systems.

1.3 Related Work

.1 This Section may not contain all materials, equipment and requirements required for the completion of this project. This Section is to be read in conjunction with the remaining Sections of Division 21, 22, 23 and all related works.

.2 Division 1 forms an integral part of Divisions 21, 22 and 23.

1.4 References

.1 Except as specified herein, the latest edition of the standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

.2 In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

.3 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME):

.1 ANSI/ASME B16.15, Cast Copper Alloy Threaded Fittings, Classes 125 and 250.

.2 ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.

.3 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

.4 ANSI/ASME B16.24, Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves Classes 150, 300, 600, 900, 1500, and 2500.

.4 ASTM International Inc.:

.1 ASTM A 307, Standard Specification for Carbon Steel Bolts, Studs and Threaded Rod 60,000 PSI Tensile Strength.

.2 ASTM A 536, Standard Specification for Ductile Iron Castings.

.3 ASTM B 88M, Standard Specification for Seamless Copper Water Tube (Metric).

.4 ASTM F876, Standard Specification for Crosslinked Polyethylene (PEX) Tubing.

.5 ASTM F877, Standard Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems.

.5 American National Standards Institute/American Water Works Association (ANSI)/(AWWA):

.1 ANSI/AWWA C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.6 Canadian Standards Association (CSA):

.1 CSA 137 Series, Thermoplastic pressure piping compendium.

.7 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

.1 Safety Data Sheets (SDS).

.8 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS):

.1 MSS-SP-67, Butterfly Valves.

.2 MSS-SP-70, Gray Iron Gate Valves, Flanged and Threaded Ends.

.3 MSS-SP-71, Gray Iron Swing Check Valves, Flanged and Threaded Ends.

.4 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.

.9 National Research Council (NRC)/Institute for Research in Construction:

.1 NRCC 38728, National Plumbing Code of Canada (NPC).

1.5 Action and Informational Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical and Section 01 33 00 - Submittal Procedures for submission requirements.

.2 Product Data: Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish, and limitations.

.3 Submit copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

1.6 Closeout Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical, Section 01 33 00 - Submittal Procedures, and Section 01 78 00 - Closeout Submittals for submission requirements.

1.7 Delivery, Storage and Handling

.1 Shipping:

.1 All equipment, material and spare parts shall be shipped, stored, handled, and installed in such a manner as not to degrade quality, serviceability, or appearance. Equipment and material warranties shall not be voided by actions of the Construction Contractor.

.2 Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

.3 Pack spare parts in containers bearing labels clearly designated contents and pieces of equipment for which intended.

.4 Deliver spare parts at same time as pertaining equipment. Deliver to City after completion of Work.

.2 Receiving:

.1 All equipment, material and spare parts shall be delivered to the Site in original packages or containers bearing the manufacturer's labels and product identification.

.2 Inspect for damage and correctness, and inventory items, upon delivery to Site.

.3 Store equipment, material and spare parts protected for the weather, humidity and temperature variations, dirt and dust or other contaminants. Store and safeguard in accordance with manufacturer's recommendations.

1.8 Quality Assurance

.1 Performance Requirements:

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

2. PRODUCTS

2.1 Piping

.1 Domestic hot, cold and recirculation systems, within building:

.1 Above ground: copper tube, hard drawn, type L: to ASTM B 88M.

.2 From trap primer to traps: Crosslinked polyethylene tube, SDR 9: ASTM F876 and ASTM F877 with no buried joints.

.2 Water piping within the process areas:

.1 PVC: Ipex Inc. “AQARISE”, ULC listed rigid, Class 150, SDR 11, 1035 kPa pressure rated CPVC pipe to CSA certified to CSA B137.

2.2 Fittings

.1 Bronze pipe flanges and flanged fittings, Class 150: to ANSI/ASME B16.24.

.2 Cast bronze threaded fittings, Class 125: to ANSI/ASME B16.15.

.3 Cast copper, solder type: to ANSI/ASME B16.18.

.4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.

.5 CPVC to CSA 137.

2.3 Joints

.1 Rubber gaskets, latex-free 1.6 mm thick: to AWWA C111.

.2 Bolts, nuts, hex head and washers: to ASTM A 307, heavy series.

.3 Solder: 95/5 tin copper alloy.

.4 Teflon tape: for threaded joints.

.5 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner.

.6 CPVC 2 step cement and primer.

2.4 Gate Valves

.1 65 mm and over, in mechanical rooms, flanged:

.1 Rising stem: to MSS-SP-70, Class 125, 860 kPa, flat flange faces, cast-iron body, OS&Y bronze trim specified Section 23 05 23.02 - Valves - Cast Iron.

.2 65 mm and over, other than mechanical rooms, flanged:

.1 Non-rising stem: to MSS-SP-70, Class 125, 860 kPa, flat flange faces, cast-iron body, bronze trim, bolted bonnet specified Section 23 05 23.02 - Valves - Cast Iron.

2.5 Ball Valves

.1 50 mm and under, screwed:

.1 Class 150.

.2 Cast high tensile bronze body, chrome plated brass ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle as specified Section 23 05 23.01 - Valves - Bronze.

.3 Manufacturer approved CPVC ball valve for CPVC pipework.

2.6 Swing Check Valves

.1 50 mm and under, screwed:

.1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 23.01 - Valves - Bronze.

.2 65 mm and over, flanged:

.1 To MSS-SP-71, Class 125, 860 kPa, cast iron body, flat flange faces, renewable seat, bronze disc, bolted cap specified Section 23 05 23.02 - Valves - Cast Iron.

2.7 Couplings – Building to Municipal Supply and Sewer Systems

.1 Center sleeve: cast ductile iron.

.2 End rings: cast ductile iron.

.3 Gaskets: SBR (Buna S) rubber.

.4 Fasteners: NC T304 stainless steel. Nuts coated with anti-galling compound.

.5 Coating: fusion bonded epoxy coating as per Section 3 of AWWA Standard C213.

3. EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Install in accordance with NPC with Provincial amendments and to the satisfaction of the local Authority Having Jurisdiction.

.2 Install pipe work in accordance with Section 23 05 05 - Installation of Pipework, supplemented as specified herein.

.3 Assemble piping using fittings manufactured to ANSI standards.

.4 Install CWS piping below and away from HWS and HWC and other hot piping to maintain temperature of cold water as low as possible.

.5 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.

.6 Buried tubing:

.1 Lay in well compacted washed sand in accordance with AWWA Class B bedding.

.2 Bend tubing without crimping or constriction.

3.3 Valves

.1 Isolate equipment, fixtures and branches with gate or ball valves.

3.4 Pressure Tests

.1 Conform to requirements of Section 21 05 01 - Common Work Results for Mechanical.

.2 Test pressure: greater of 1.5 times the maximum system operating pressure or 860 kPa.

3.5 Flushing and Cleaning

.1 Flush entire system for eight (8) hours. Ensure outlets flushed for two (2) hours. Let stand for twenty-four (24) hours, then draw one (1) sample off longest run. Submit to testing laboratory to verify that system is clean to Provincial or Federal potable water guidelines. Let system flush for additional two (2) hours, then draw off another sample for testing. If test results are do not meet guidelines repeat procedure until guideline requirements are met.

3.6 Pre-Start Up Inspections

.1 Systems to be complete, prior to flushing, testing and start-up.

.2 Verify that system can be completely drained.

.3 Ensure that pressure booster systems are operating properly.

.4 Ensure that air chambers, expansion compensators are installed properly.

3.7 Disinfection

.1 Flush out, disinfect and rinse system to requirements of Authority Having Jurisdiction.

.2 Upon completion, provide laboratory test reports on water quality for Contract Administrator’s approval.

3.8 Start-up

.1 Timing: start up after:

.1 Pressure tests have been completed.

.2 Disinfection procedures have been completed.

.2 Provide continuous supervision during start-up.

.3 Start-up procedures:

.1 Establish circulation and ensure that air is eliminated.

.2 Bring domestic hot water (DHW) system up to design temperature slowly.

.3 Monitor DHW and domestic cold water (DCW) piping systems for freedom of movement, pipe expansion as designed.

.4 Check control, limit, safety devices for normal and safe operation.

.4 Rectify start-up deficiencies.

3.9 Performance Verification

.1 Scheduling:

.1 Verify system performance after pressure and leakage tests and disinfection are completed, and Certificate of Completion has been issued by Authority Having Jurisdiction.

.2 Procedures:

.1 Verify that flow rate and pressure meet Design Criteria.

.2 TAB domestic water system in accordance with Section 23 05 93.10 - Testing and Section 23 05 93.20 – Testing, Adjusting, and Balancing for HVAC.

.3 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.

.4 Sterilize DHW and DCW systems for Legionella control.

.5 Verify performance of temperature controls.

.6 Verify compliance with safety and health requirements.

.7 Check for proper operation of water hammer arrestors. Run one (1) outlet for ten (10) seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.

.8 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.

.3 Reports:

.1 In accordance with Section 01 91 31 - Commissioning Plan, using report forms as specified in Section 01 91 31 - Commissioning Plan.

.2 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

3.10 Cleaning

.1 Remove surplus materials, excess materials, rubbish, tools, and equipment.

END OF SECTION

1. GENERAL

1.1 Description

.1 For additional information, refer to Section 21 05 01 - Common Work Results for Mechanical and Division 1 - General Conditions of the Construction Contract.

.2 For a list of applicable codes and standards, refer to Section 21 05 01 - Common Work Results for Mechanical.

.3 The Construction Contractor shall be responsible for coordinating all aspects of this Work.

.4 Locations of equipment, ductwork, pipework, and all associated appurtenances indicated on the Drawings are approximate only. The Construction Contractor is responsible for checking and coordinating the locations of equipment, ductwork, pipework, and all associated appurtenances and shall make any necessary adjustments in positions to conform with the architectural features, other services, symmetry, clearances, and lighting arrangements.

1.2 Scope of Work

.1 The Scope of Work for this Section includes, but is not limited to, the following:

.1 Materials and procedures for the provision and installation of pipework and fittings for sanitary drainage and vent systems.

1.3 Related Work

.1 This Section may not contain all materials, equipment and requirements required for the completion of this project. This Section is to be read in conjunction with the remaining Sections of Division 21, 22 and 23 and all related works.

.2 Division 1 forms an integral part of Divisions 21, 22 and 23.

1.4 References

.1 Except as specified herein, the latest edition of the standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

.2 In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

.3 ASTM International Inc.:

.1 ASTM D 2235, Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.

.2 ASTM D 2564, Standard Specification for Solvent Cements for Poly (Vinyl-Chloride) (PVC) Plastic Piping Systems.

.3 ASTM D3222, Standard Specification for Unmodified Poly (Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

.1 Safety Data Sheets (SDS).

1.5 Action and Informational Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical and Section 01 33 00 - Submittal Procedures for submission requirements.

.2 Product Data: Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Submit copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

1.6 Closeout Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical, Section 01 33 00 - Submittal Procedures, and Section 01 78 00 - Closeout Submittals for submission requirements.

1.7 Delivery, Storage and Handling

.1 Shipping:

.1 All equipment, material and spare parts shall be shipped, stored, handled, and installed in such a manner as not to degrade quality, serviceability, or appearance. Equipment and material warranties shall not be voided by actions of the Construction Contractor.

.2 Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

.3 Pack spare parts in containers bearing labels clearly designated contents and pieces of equipment for which intended.

.4 Deliver spare parts at same time as pertaining equipment. Deliver to the City after completion of Work.

.2 Receiving:

.1 All equipment, material and spare parts shall be delivered to the Site in original packages or containers bearing the manufacturer's labels and product identification.

.2 Inspect for damage and correctness, and inventory items, upon delivery to Site.

.3 Store equipment, material and spare parts protected for the weather, humidity and temperature variations, dirt and dust or other contaminants. Store and safeguard in accordance with Manufacturer's recommendations.

1.8 Quality Assurance

.1 Performance Requirements:

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

2. PRODUCTS

2.1 Pipe

	Service	Material
.1	Sanitary drainage, and vent, inside building, above ground	DWV copper, ASTM B306 Cast iron, CSA B70
.2	Sanitary drainage, and vent, inside building, below ground	Cast iron, CSA B70 PVC-DWV, CAN/CSA B182.1
.3	Equipment drains and overflows	Sch.40, galvanised steel, ASTM A120 Type L hard copper ASTM B88M

2.2 Fittings and Joints

	Service	Material	Joint
.1	Sanitary drainage and vent inside building, above ground	Cast iron Wrought or Cast copper	Gasket clamp Lead-free Solder
.2	Sanitary drainage and vent, inside building, below ground	Cast iron (hubless fitting) PVC-DWV	Gasket & clamp Solvent weld
.3	Equipment drains and overflows	Galvanised banded malleable iron Wrought copper, bronze Cast brass	Screwed 50-50 solder Screwed

.4 Use long radius elbows for steel and cast iron water piping, including grooved mechanical fittings.

3. EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 In accordance with Section 23 05 05 - Installation of Pipework, National Plumbing Code with Provincial amendments and to the satisfaction of the local Authority Having Jurisdiction.

3.3 Testing

.1 Pressure test buried systems before backfilling.

.2 Hydraulically test to verify grades and freedom from obstructions.

3.4 Performance Verification

.1 Cleanouts:

.1 Ensure accessible and that access doors are correctly located.

.2 Open, cover with linseed oil and re-seal.

.3 Verify cleanout rods can probe at least as far as the next cleanout.

.2 Test to ensure traps are fully and permanently primed.

.3 Ensure fixtures are properly anchored, connected to system and effectively vented.

.4 Affix applicable label (storm, sanitary, vent, pump discharge) complete with directional arrows every floor or 4.5 m (whichever is less).

3.5 Cleaning

.1 Remove surplus materials, excess materials, rubbish, tools, and equipment.

END OF SECTION

1. GENERAL

1.1 Description

.1 For additional information, refer to Section 21 05 01 - Common Work Results for Mechanical and Division 1 - General Conditions of the Construction Contract.

.2 For a list of applicable codes and standards, refer to Section 21 05 01 - Common Work Results for Mechanical.

.3 The Construction Contractor shall be responsible for coordinating all aspects of this Work.

.4 Locations of equipment, ductwork, pipework, and all associated appurtenances indicated on the Drawings are approximate only. The Construction Contractor is responsible for checking and coordinating the locations of equipment, ductwork, pipework, and all associated appurtenances and shall make any necessary adjustments in positions to conform with the architectural features, other services, symmetry, clearances, and lighting arrangements.

1.2 Scope of Work

.1 The Scope of Work for this Section includes, but is not limited to, the following:

.1 Materials and procedures for the provision and installation of plumbing specialties and accessories to plumbing systems.

1.3 Related Work

.1 This Section may not contain all materials, equipment and requirements required for the completion of this project. This Section is to be read in conjunction with the remaining Sections of Division 21, 22 and 23 and all related works.

.2 Division 1 forms an integral part of Division 21, 22 and 23.

1.4 References

.1 Except as specified herein, the latest edition of the standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

.2 In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

.3 American Society for Testing and Materials International (ASTM):

.1 ASTM A 126, Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.

.2 ASTM B 62, Standard Specification for Composition Bronze or Ounce Metal Castings.

.4 Canadian Standards Association (CSA International):

.1 CSA-B64 Series, Backflow Preventers and Vacuum Breakers.

.2 CSA-B79, Commercial Residential Drains and Cleanouts.

.3 CSA-B356, Water Pressure Reducing Valves for Domestic Water Supply Systems.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

.1 Safety Data Sheets (SDS).

.6 Plumbing and Drainage Institute (PDI):

.1 PDI-G101, Testing and Rating Procedure for Hydro Mechanical Grease Interceptors with Appendix of Installation and Maintenance.

.2 PDI-WH201, Water Hammer Arresters Standard.

1.5 Action and Informational Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical and Section 01 33 00 - Submittal Procedures for submission requirements.

.2 Product Data: Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Submit copies of WHMIS SDS - Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

1.6 Closeout Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical, Section 01 33 00 - Submittal Procedures, and Section 01 78 00 - Closeout Submittals for submission requirements.

1.7 Delivery, Storage and Handling

.1 Shipping:

.1 All equipment, material and spare parts shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability, or appearance. Equipment and material warranties shall not be voided by actions of the Construction Contractor.

.2 Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

.3 Pack spare parts in containers bearing labels clearly designated contents and pieces of equipment for which intended.

.4 Deliver spare parts at same time as pertaining equipment. Deliver to the City after completion of Work.

.2 Receiving:

.1 All equipment, material and spare parts shall be delivered to the Site in original packages or containers bearing the manufacturer's labels and product identification.

.2 Inspect for damage and correctness, and inventory items, upon delivery to Site.

.3 Store equipment, material and spare parts protected for the weather, humidity and temperature variations, dirt and dust or other contaminants. Store and safeguard in accordance with manufacturer's recommendations.

1.8 Quality Assurance

.1 Performance Requirements:

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

2. PRODUCTS

2.1 Floor Drains

.1 Body: epoxy coated, cast iron body, reversible flashing clamp with primary and secondary weepholes, trap primer connection with plug, no hub outlet.

.2 Strainer: nickel bronze adjustable strainer, 127 mm diameter.

2.2 Trap Seal Primers

.1 Electronic trap primer assembly complete with twenty-four (24) hour clock, atmospheric vacuum breaker, solenoid valve (120 V), manual override, isolation valve and surface mount NEMA-1 cabinet with 12 mm copper or PEX connections between primer assembly and floor drains. Contractor to confirm quantity of drains served.

.2 Acceptable product:

.1 Precision Plumbing Products (PPP) model PTS.

.2 Or approved equivalent.

2.3 Cleanouts

.1 Floor cleanout:

.1 Body: epoxy coated, cast iron body, adjustable gasketed nickel bronze top 127 mm diameter, no hub outlet.

.2 Wall mounted stack cleanout:

.1 Body: cast iron body, removable, gasketed, brass plug, round, access cover, stainless steel cover, no hub outlet.

2.4 Water Hammer Arrestors

.1 Copper construction, piston type: to PDI-WH201.

2.5 Back Flow Preventers

.1 Back Flow Preventers: to CSA-B64 Series.

.2 Reduced Pressure Zone Assembly: Two (2) positive seating check modules, lead free cast copper silicon alloy body for up to 50 mm and fused epoxy coated cast iron body for 65 mm and above, captured spring assemblies, replaceable seats and silicone seat discs, single access bronze cover secured with stainless steel bolts, internal pressure differential relief valve in between check modules, two (2) resilient seated isolation valves quarter turn ball-valves, 50 mm pipe connection, four resilient seated, screw driver slotted test cocks, bronze strainer, union connections, air gap drain fitting assembly.

2.6 Vacuum Breakers

.1 Breakers: to CSA-B64 Series, vacuum breaker atmospheric or laboratory faucet intermediate.

2.7 Hose Bibb (Interior)

.1 Cast bronze wall hydrant with vacuum breaker. Meets NSF/ANSI 372.

.2 Standard of Acceptance: Zurn 195XL-VB.

.3 Provide with heavy duty rubber “Y” hose connection when used with hose reel HR-1

2.8 Hose Bibb (Exterior)

.1 Non-freeze wall hydrant with vacuum breaker. Brass interior parts and operating key, stainless steel cover plate and box.

.2 Standard of Acceptance: Zurn ZN-1320-15.

2.9 Hose Reel

.1 Hose Reel: air or water medium, strong, durable and highly corrosive resistant reel with 20 mm rubber hose, 15 m length, 1.5 MPa (218 psi) maximum working pressure.

.2 Standard of Acceptance: Nederman Model hose reel series. 884 complete with pivoting wall bracket and ABS plastic covering.

2.10 Domestic Water Heaters

.1 Equipped with extruded high-density anode.

.2 All internal surfaces of the heater(s) exposed to water shall be glass lined with an alkaline borosilicate composition that has been fused-to-steel by firing at a temperature range of 1400°F to 1600°F.

.3 Electric heating elements shall be low watt density. Each element shall be controlled by an individually mounted thermostat and high temperature cut-off switch.

.4 All internal circuits shall be fused.

.5 The outer jacket shall be of baked enamel finish and shall be provided with full size control compartment for performance of service and maintenance through front panel and shall enclose the tank with foam insulation.

.6 Electrical junction box with heavy duty terminal block shall be provided.

.7 The drain valve shall be located near the front for ease of servicing.

.8 Manufacturer shall supply ASME rated temperature and pressure relief valve.

.9 Complete with drip pan.

.10 Refer to equipment schedules for specific selection.

2.1 Hot Water Storage Tank

.1 To CAN/CSA C22.2 No.110, CAN/CSA-C19 and CAN/CSA-C309 for glass-lined storage tanks.

.2 Interior shall be coated with a high temperature porcelain enamel and furnished with two (2) magnesium anode rod(s) rigidly supported.

.3 Tank shall be insulated with a minimum of 2" of rigid polyurethane foam insulation.

.4 The drain valve shall be located near the front for ease of servicing.

.5 Manufacturer shall supply ASME rated temperature and pressure relief valve.

.6 Complete with drip pan.

.7 Refer to equipment schedules for specific selection.

2.2 Expansion Tanks – Diaphragm Type

.1 Deep drawn steel dome pressurized diaphragm type expansion tank.

.2 Capacity: as scheduled.

.3 Butyl diaphragm suitable for maximum 93°C operating temperature.

.4 Working pressure: 1034 kPa with ASME stamp and certification.

.5 Air precharged to 379 kPa (initial fill pressure of system).

3. EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Install in accordance with National Plumbing Code of Canada and Manitoba Plumbing Code and to the satisfaction of the local Authority Having Jurisdiction.

3.3 Cleanouts

.1 Install cleanouts at base of soil and waste stacks, and rainwater leaders, at locations required code, and as indicated.

.2 Bring cleanouts to wall or finished floor unless serviceable from below floor.

.3 Building drain cleanout and stack base cleanouts: line size to maximum 100 mm.

3.4 Water Hammer Arrestors

.1 Install on branch supplies to fixtures or group of fixtures.

3.5 Back Flow Preventors

.1 Install in accordance with CSA-B64 Series, where indicated and elsewhere as required by code.

.2 Pipe discharge to terminate over nearest drain.

3.6 Trap Seal Primer

.1 Install for floor and trench drains and elsewhere, as indicated.

.2 Install plastic tubing to floor drains.

3.7 Start-Up

.1 General:

.1 In accordance with Section 01 91 31 - Commissioning Plan, supplemented as specified herein.

.2 Timing: start-up only after:

.1 Pressure tests have been completed.

.2 Disinfection procedures have been completed.

.3 Provide continuous supervision during start-up.

3.8 Testing and Adjusting

.1 General:

.1 In accordance with Section 01 91 31 - Commissioning Plan, supplemented as specified.

.2 Timing:

.1 After start-up deficiencies rectified.

.2 After certificate of completion has been issued by Authority Having Jurisdiction.

.3 Application tolerances:

.1 Pressure at fixtures: plus or minus 10 kPa of incoming water pressure.

.4 Adjustments:

.1 Verify that flow rate and pressure meet design criteria.

.2 Make adjustments while flow rate or withdrawal is (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.

.5 Floor and trench drains:

.1 Verify operation of trap seal primer.

.2 Prime, using trap primer. Adjust flow rate to suit Site conditions.

.3 Check operations of flushing features.

.4 Check security, accessibility, removeability of strainer.

.5 Clean out baskets.

.6 Vacuum breakers, backflow preventers, backwater valves:

.1 Test tightness, accessibility for O&M of cover and of valve.

.2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.

.3 Verify visibility of discharge from open ports.

.7 Cleanouts:

.1 Verify covers are gas-tight, secure, yet readily removable.

.8 Water hammer arrestors:

.1 Verify proper installation of correct type of water hammer arrester.

.9 Commissioning Reports:

.1 In accordance with Section 01 91 31 - Commissioning Plan, supplemented as specified.

.10 Training:

.1 In accordance with Section 01 79 00 – Demonstration and Training, supplemented as specified.

.2 Demonstrate full compliance with Design Criteria.

3.9 Cleaning

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1. GENERAL

1.1 Description

.1 For additional information, refer to Section 21 05 01 - Common Work Results for Mechanical and Division 1 - General Conditions of the Construction Contract.

.2 For a list of applicable codes and standards, refer to Section 21 05 01 - Common Work Results for Mechanical.

.3 The Construction Contractor shall be responsible for coordinating all aspects of this Work.

.4 Locations of equipment, ductwork, pipework, and all associated appurtenances indicated on the Drawings are approximate only. The Construction Contractor is responsible for checking and coordinating the locations of equipment, ductwork, pipework, and all associated appurtenances and shall make any necessary adjustments in positions to conform with the architectural features, other services, symmetry, clearances, and lighting arrangements.

1.2 Scope of Work

.1 The Scope of Work for this Section includes, but is not limited to, the following:

.1 Materials and procedures for the provision and installation of plumbing fixtures and fittings.

1.3 Related Work

.1 This Section may not contain all materials, equipment and requirements required for the completion of this project. This Section is to be read in conjunction with the remaining Sections of Division 21, 22 and 23 and all related works.

.2 Division 1 forms an integral part of Division 21, 22 and 23.

1.4 References

.1 Except as specified herein, the latest edition of the standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

.2 In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

.3 American National Standards Institute (ANSI):

.1 ANSI Z358.1, American National Standard for Emergency Eyewash and Shower Equipment.

.4 ASTM International Inc.:

.1 ASTM D4101, Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials.

.5 Canadian Standards Association (CSA International):

.1 CAN/CSA-B45 Series, Plumbing Fixtures.

.2 CAN/CSA-B125.3, Plumbing Fittings.

.3 CAN/CSA-B651, Accessible Design for the Built Environment.

1.5 Action and Informational Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical and Section 01 33 00 - Submittal Procedures for submission requirements.

.2 Product Data: Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Submit copies of WHMIS SDS - Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

1.6 Closeout Submittals

.1 Refer to Section 21 05 01, "Common Work Results for Mechanical", Section 01 33 00 “Submittal Procedures”, and Section 01 78 00, “Closeout submittals” for submission requirements.

1.7 Delivery, Storage and Handling

.1 Shipping:

.1 All equipment, material and spare parts shall be shipped, stored, handled, and installed in such a manner as not to degrade quality, serviceability, or appearance. Equipment and material warranties shall not be voided by actions of the Construction Contractor.

.2 Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

.3 Pack spare parts in containers bearing labels clearly designated contents and pieces of equipment for which intended.

.4 Deliver spare parts at same time as pertaining equipment. Deliver to the City after completion of Work.

.2 Receiving:

.1 All equipment, material and spare parts shall be delivered to the Site in original packages or containers bearing the manufacturer's labels and product identification.

.2 Inspect for damage and correctness, and inventory items, upon delivery to Site.

.3 Store equipment, material and spare parts protected for the weather, humidity and temperature variations, dirt and dust or other contaminants. Store and safeguard in accordance with manufacturer's recommendations.

1.8 Quality Assurance

.1 Performance Requirements:

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

2. PRODUCTS

2.1 Manufactured Units

.1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.

.2 Trim, fittings: manufacture in accordance with CAN/CSA-B125.3.

.3 Exposed plumbing brass to be chrome plated.

.4 Fixtures in any one location to be product of one manufacturer and of same type.

.5 Trim in any one location to be product of one manufacturer and of same type.

2.2 Sample Sink - SK

.1 Construct according to Sample Sink Detail on drawings.

2.3 Emergency Eye/Face Wash - EEW

.1 Eye/Face Wash:

.1 Wall-mounted eye/face wash shall include a stainless steel 27.9 cm (11 inch) round bowl with 32 mm NPT waste.

.2 Eyewash streams provide zero vertical velocity inverted laminar flow.

.3 Yellow plastic pop-off dust cover for eyewash head supplied by an integral 3.7 gpm flow control, and stainless steel ball valve equipped with stainless steel ball and stem.

.4 Complete with stainless steel dust cover for the bowl.

.5 Complete with stainless steel wall bracket.

.6 Universal sign, 1/2" NPT inlet.

.7 Test Tag: Is a green waterproof test card with space for date and initials of inspector. Used to record weekly testing of emergency equipment.

.8 Certified by CSA to meet the ANSI Z358.1 Standard for Emergency Eyewash and Shower Equipment.

.9 Standard of acceptance: Haws Model 7360B-7460B.

.2 Tempering (Mixing) Valve (MV):

.1 Materials: Constructed of lead-free bronze, brass, copper, and stainless steel.

.2 37.8 L/min maximum flowrate.

.3 Maximum inlet pressure: 862 kPa.

.4 Valve rated for a maximum inlet temperature of 82°C and an outlet temperature of 29ºC, factory set.

.5 Redundant anti-scald protection with internal cold water bypass. Main tempering valve provides primary protection while backup shutoff valve provides secondary high-temp protection. Internal cold water bypass supplies cold water if hot water supply or main tempering valve fails.

.6 Complete with surface mounted stainless steel wall cabinet.

.7 Complete with temperature gauge with minus 20 to 95°C range.

.8 Standard of Acceptance: Haws Model 9201EW.

.3 Flow Switch for Emergency Eye/Face Wash (FS):

.1 Pipe mounted, emergency alarm and light system operated by a double pole, double throw flow switch at a flow rate of 0.15 l/sec.

.2 Contains multiple sets of contacts for remote activation.

.3 Complete with amber flashing beacon and sounder producing a minimum of 90 db at 3.05 m (10 ft). Buzzer shall be capable of being silenced during testing.

.4 Voltage: 120 VAC, 60 cycles and CSA electrically certified as TYPE 4.

.5 Standard of Acceptance: Haws Model 9001.

2.4 Emergency Shower and Eye/Face Wash Combination - EEWS

.1 Shower and Eye/Face Wash:

.1 Eyewash streams provide zero vertical velocity inverted laminar flow.

.2 Yellow plastic pop-off dust cover for eyewash head.

.3 ABS plastic drench showerhead with flow control delivers dispersed flow for uniform drenching.

.4 Stainless steel push flag for eyewash activation, stainless steel pull rod for shower activation.

.5 Round 27.9 cm (11 inch) stainless steel bowl.

.6 Mesh in-line eyewash strainer to collect line debris.

.7 Ball valves with stainless steel ball and stem.

.8 32 mm Schedule 40 hot-dipped galvanized steel piping and cast-iron 229 mm diameter floor flange all with green corrosion resistant epoxy coating.

.9 Supply and Waste: 32 mm NPT.

.10 Self-adhesive high visibility safety green and bright yellow stripes.

.11 Test Tag: Is a green waterproof test card with space for date and initials of inspector. Used to record weekly testing of emergency equipment.

.12 Certified by CSA to meet the ANSI Z358.1 Standard for Emergency Eyewash and Shower.

.13 Standard of Acceptance: Haws Model 8300CRP – 8309CRP.

.2 Shower/Eyewash Sign:

.1 Large vertical universal combination emergency shower and eyewash sign. Size: 457 mm x 610 mm.

.2 Standard of acceptance: Haws Model SP178LG.

.3 Tempering (Mixing) Valve (MV):

.1 Materials: Constructed of lead-free bronze, brass, copper, and stainless steel.

.2 1.95 L/s maximum flowrate.

.3 Maximum inlet pressure: 862 kPa.

.4 Valve rated for a maximum inlet temperature of 82°C and an outlet temperature of 26°C, factory set.

.5 Redundant anti-scald protection with internal cold water bypass. Main tempering valve provides primary protection while backup shutoff valve provides secondary high-temp protection. Internal cold water bypass supplies cold water if hot water supply or main tempering valve fails.

.6 Complete with surface mounted stainless steel wall cabinet.

.7 Complete with temperature gauge with minus 20-95°C range.

.8 Standard of Acceptance: Haws Model 9201H.

.4 Flow Switch for Safety Shower (FS):

.1 Pipe mounted, emergency alarm and light system operated by a double pole, double throw flow switch at a flow rate of 0.15 l/sec.

.2 Contains multiple sets of contacts for remote activation.

.3 Complete with amber flashing beacon and sounder producing a minimum of 90 db at 3.05 m (10 ft). Buzzer shall be capable of being silenced during testing.

.4 Voltage: 120 VAC, 60 cycles and CSA electrically certified as TYPE 4.

.5 Standard of Acceptance: Haws Model 9001.

3. EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Mounting heights:

.1 Standard: to manufacturer's recommendations.

3.3 Adjusting

.1 Adjustments:

.1 Adjust water flow rate to design flow rates.

.2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.

.2 Checks:

.1 Emergency eyewashes and shower: Flow switch and alarm.

.3 Thermostatic Controls:

.1 Verify temperature settings, operation of control, limit, and safety controls.

3.4 Cleaning

.1 Remove surplus materials, excess materials, rubbish, tools, and equipment.

END OF SECTION

INSTALLATION OF PIPEWORK

1. GENERAL

1.1 Description

.1 For additional information, refer to Section 21 05 01 - Common Work Results for Mechanical and Division 1 - General Conditions of the Construction Contract.

.2 For a list of applicable codes and standards, refer to Section 21 05 01 - Common Work Results for Mechanical.

.3 The Construction Contractor shall be responsible for coordinating the Work.

.4 Locations of equipment, ductwork, pipework, and all associated appurtenances indicated on the Drawings are approximate only. The Construction Contractor is responsible for checking and coordinating the locations of equipment, ductwork, pipework, and all associated appurtenances and shall make any necessary adjustments in positions to conform to the architectural features, other services, symmetry, clearances, and lighting arrangements.

1.2 Scope of Work

.1 The Scope of Work for this Section includes, but is not limited to, the following:

.1 Materials and procedures for the provision and installation of process hot and cold water pipework, domestic hot and cold water pipework, and refrigeration pipework.

1.3 Related Work

.1 This Section may not contain all materials, equipment and requirements required for the completion of this project. This Section is to be read in conjunction with the remaining Sections of Division 21, 22 and 23 and all related works.

.2 Division 1 forms an integral part of Division 21, 22 and 23.

1.4 References

.1 Except as specified herein, the latest edition of the standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

.2 In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

.3 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating.

.4 National Fire Code of Canada (NFCC).

1.5 Action and Informational Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical and Section 01 33 00 - Submittal Procedures for submission requirements.

.2 Product Data: Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Submit copies of WHMIS SDS - Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

1.6 Closeout Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical, Section 01 33 00 - Submittal Procedures, and Section 01 78 00 - Closeout Submittals for submission requirements.

1.7 Delivery, Storage and Handling

.1 Shipping:

.1 All equipment, material and spare parts shall be shipped, stored, handled, and installed in such a manner as not to degrade quality, serviceability, or appearance. Equipment and material warranties shall not be voided by actions of the Construction Contractor.

.2 Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

.3 Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.

.4 Deliver spare parts at same time as related equipment. Deliver to the City after completion of Work.

.2 Receiving:

.1 All equipment, material and spare parts shall be delivered to the Site in original packages or containers bearing the manufacturer's labels and product identification.

.2 Inspect for damage and correctness, and inventory items, upon delivery to Site.

.3 Store equipment, material and spare parts protected for the weather, humidity and temperature variations, dirt and dust or other contaminants. Store and safeguard in accordance with manufacturer's recommendations.

1.8 Quality Assurance

.1 Performance Requirements:

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

2. PRODUCTS

2.1 Material

.1 Paint: zinc-rich to CAN/CGSB-1.181.

.1 Primers and Paints: apply in accordance with manufacturer's recommendations for surface conditions.

3. EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Connections to Equipment

.1 In accordance with manufacturer's instructions unless otherwise indicated.

.2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

.3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.3 Clearances

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

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer without interrupting operation of other system, equipment, components.

3.4 Drains

.1 Install piping with grade in direction of flow except as indicated.

.2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.

.3 Pipe each drain valve discharge separately to above floor drain, discharge to be visible.

.4 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

3.5 Air Vents

.1 Install manual air vents at high points in piping systems.

.2 Install isolating valve at each automatic air valve.

.3 Install drain piping to approved location and terminate where discharge is visible.

3.6 Dielectric Couplings

.1 General: compatible with system, to suit pressure rating of system.

.2 Locations: where dissimilar metals are joined.

.3 50 mm and smaller: isolating unions or bronze valves.

.4 Over 50 mm: isolating flanges.

3.7 Pipework Installation

.1 Install pipework to industry standard practices.

.2 Screwed fittings jointed with Teflon tape.

.3 Protect openings against entry of foreign material.

.4 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

.5 Assemble piping using fittings manufactured to ASME standards.

.6 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.

.1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.

.7 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

.8 Install concealed pipework to minimize furring space, maximize headroom, and conserve space.

.9 Slope piping, except where indicated, in direction of flow for positive drainage and venting.

.10 Install, except where indicated, to permit separate thermal insulation of each pipe.

.11 Group piping wherever possible.

.12 Ream pipes, remove scale and other foreign material before assembly.

.13 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

.14 Provide for thermal expansion as indicated.

.15 Valves:

.1 Install in accessible locations.

.2 Remove interior parts before soldering.

.3 Install with stems above horizontal position unless indicated.

.4 Valves accessible for maintenance without removing adjacent piping.

.5 Install globe valves in bypass around control valves.

.6 Use ball valves at branch take-offs for isolating purposes except where specified.

.16 Check Valves:

.1 Install silent check valves on discharge of pumps and as indicated.

3.8 Sleeves

.1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and as indicated.

.2 Material: schedule 40 black steel pipe.

.3 Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.

.4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.

.5 Installation:

.1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.

.2 Other floors: terminate 25 mm above finished floor.

.3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.

3.9 Escutcheons

.1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.

.2 Construction: one piece type with set screws.

.1 Chrome or nickel plated brass or Type 302 stainless steel.

.3 Sizes: outside diameter to cover opening or sleeve.

.1 Inside diameter to fit around pipe or outside of insulation if so provided.

3.10 Preparation for Firestopping

.1 Install fire stopping within annular space between pipes, ducts, insulation and adjacent fire separation in accordance with Section 07 84 00 - Firestopping.

.2 Uninsulated unheated pipes not subject to movement: no special preparation.

.3 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe movement without damaging firestopping material or installation.

.4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

3.11 Pressure Testing of Equipment and Pipework

.1 Provide testing work plan complete with narrative and drawings of tested pipework.

.2 Advise Contract Administrator forty-eight (48) hours minimum prior to performance of pressure tests.

.3 Pipework: test as specified in relevant sections of heating, ventilating and air conditioning work.

.4 Maintain specified test pressure without loss for eight (8) hours minimum unless specified for longer period of time in relevant mechanical sections.

.5 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.

.6 Conduct tests in presence of Contract Administrator.

.7 Pay costs for repairs or replacement, retesting, and making good. Contract Administrator to determine whether repair or replacement is appropriate.

.8 Insulate or conceal work only after approval and certification of tests by Contract Administrator.

3.12 Cleaning

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PIPE WELDING

1. GENERAL

1.1 Related Requirements

.1 Section 21 05 01 – Common Work Results for Mechanical.

1.2 References

.1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME):

.1 ANSI/ASME B31.3, Process Piping.

.2 ANSI/ASME Boiler and Pressure Vessel Code (BPVC Section VIII):

.1 BPVC 2007 Section I: Power Boilers.

.2 BPVC 2007 Section V: Nondestructive Examination.

.3 BPVC 2007 Section IX: Welding and Brazing Qualifications.

.2 American National Standards Institute/American Water Works Association (ANSI/AWWA):

.1 ANSI/AWWA C206, Field Welding of Steel Water Pipe.

.3 American Welding Society (AWS):

.1 AWS C1.1M/C1.1, Recommended Practices for Resistance Welding.

.2 AWS Z49.1, Safety in Welding, Cutting and Allied Process.

.3 AWS W1, Welding Inspection Handbook.

.4 Canadian Standards Association (CSA):

.1 CSA W47.2, Certification of Companies for Fusion Welding of Aluminum.

.2 CSA W48, Filler Metals and Allied Materials for Metal Arc Welding.

.3 CSA B51, Boiler, Pressure Vessel and Pressure Piping Code.

.4 CSA-W117.2, Safety in Welding, Cutting and Allied Processes.

.5 CSA W178.1, Certification of Welding Inspection Organizations.

.6 CSA W178.2, Certification of Welding Inspectors.

1.3 Action and Informational Submittals

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

1.4 Quality Assurance

.1 Qualifications:

.1 Welders:

.1 Welding qualifications in accordance with CSA B51.

.2 Use qualified and licensed welders possessing certificate for each procedure performed from Authority Having Jurisdiction.

.3 Submit welder's qualifications to Contract Administrator.

.4 Certification of companies for fusion welding of aluminum in accordance with CSA W47.2.

.2 Inspectors:

.1 Inspectors qualified to CSA W178.2.

.3 Certifications:

.1 Registration of welding procedures in accordance with CSA B51.

.2 Copy of welding procedures available for inspection.

.3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.

1.5 Delivery, Storage and Handling

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

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

2. PRODUCTS

2.1 Electrodes

.1 Electrodes: in accordance with CSA W48 Series.

3. EXECUTION

3.1 Application

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

3.2 Quality of Work

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

3.3 Installation Requirements

.1 Identify each weld with welder's identification symbol.

.2 Backing rings:

.1 Where used, fit to minimize gaps between ring and pipe bore.

.2 Do not install at orifice flanges.

.3 Fittings:

.1 NPS 2 and smaller: install welding type sockets.

.2 Branch connections: install welding tees or forged branch outlet fittings.

3.4 Inspection and Tests - General Requirements

.1 Review weld quality requirements and defect limits of applicable codes and standards with Contract Administrator before work is started.

.2 Do not conceal welds until they have been inspected, tested and approved by inspector.

.3 Provide for inspector to visually inspect welds during early stages of welding procedures in accordance with Welding Inspection Handbook. Repair or replace defects as required by codes and as specified.

3.5 Specialist Examinations and Tests

.1 General:

.1 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of Authority Having Jurisdiction.

.2 Visual examinations: include entire circumference of weld externally.

3.6 Defects Causing Rejection

.1 As described in ANSI/ASME Boiler and Pressure Vessels Code.

3.7 Repair of Welds Which Failed Tests

.1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

3.8 Cleaning

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

END OF SECTION

SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

1. GENERAL

1.1 Description

.1 Provide sleeves, stack-sleeve fittings, sleeve-seal systems, sleeve-seal fittings, grout and silicone sealants as indicated and in compliance with Contract Documents.

1.2 References

.1 ASTM International (ASTM):

.1 A53: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

.2 C920: Standard Specification for Elastomeric Joint Sealants.

.3 C1077: Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.

.1 C1107/C1107M: Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

1.3 Action and Informational Submittals

.1 Refer to Section 21 05 01 – Common Work Results for Mechanical and Section 01 33 00 – Submittal Procedures for submission requirements.

.2 Product Data: Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Submit copies of WHMIS SDS – Safety Data Sheets in accordance with Section 02 81 01 – Hazardous Materials.

1.4 Closeout Submittals

.1 Refer to Section 21 05 01 – Common Work Results for Mechanical, Section 01 33 00 – Submittal Procedures, and Section 01 78 00 – Closeout Submittals for submission requirements.

1.5 Delivery, Storage and Handling

.1 Shipping:

.1 All equipment, material and spare parts shall be shipped, stored, handled, and installed in such a manner as not to degrade quality, serviceability, or appearance. Equipment and material warranties shall not be voided by actions of the Construction Contractor.

.2 Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

.3 Pack spare parts in containers bearing labels clearly designated contents and pieces of equipment for which intended.

.4 Deliver spare parts at same time as pertaining equipment. Deliver to the City after completion of Work.

.2 Receiving:

.1 All equipment, material and spare parts shall be delivered to the Site in original packages or containers bearing the manufacturer's labels and product identification.

.2 Inspect for damage and correctness, and inventory items, upon delivery to Site.

.3 Store equipment, material and spare parts protected for the weather, humidity and temperature variations, dirt and dust or other contaminants. Store and safeguard in accordance with Manufacturer's recommendations.

1.6 Quality Assurance

.1 Performance Requirements:

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

2. PRODUCTS

2.1 Sleeves

.1 Acceptable Manufacturers:

.1 Link-Seal.

.2 Metraflex.

.3 Or approved equivalent.

.2 Steel Pipe Sleeves: ASTM A53, Type E, Grade B, Schedule 40, zinc coated, with plain ends and integral welded waterstop collar for new construction.

2.2 Stack-Sleeve Fittings

.1 Description: Manufactured, Dura-coated or Duco-coated cast-iron sleeve with integral cast flashing flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.

.1 Underdeck Clamp: Clamping ring with setscrews.

2.3 Sleeve-Seal Systems

.1 Acceptable Manufacturers:

.1 Link-Seal.

.2 Metraflex.

.3 Or approved equivalent.

.2 Description:

.1 Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

.2 Designed to form a hydrostatic seal of 138 kPag (20-psig) minimum.

.3 Designed for a temperature range of -40°C to 121°C (-40°F to 250°F).

.4 Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.

.5 Pressure Plates: Composite plastic.

.6 Connecting Bolts and Nuts: 316 stainless steel of length required to secure pressure plates to sealing elements.

2.4 Grout

.1 Description: Non-shrink, recommended for interior and exterior sealing openings in nonfire-rated walls or floors.

.2 Standard: ASTM C1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

.3 Design Mix: 34.5 MPa (5000-psi), 28-day compressive strength.

2.5 Silicone Sealants

.1 Silicone, S, NS, 25, NT: Single-component, non-sag, +25% and -25% movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C920, Type S, Grade NS, Class 25, use NT.

.2 Silicone, S, P, 25, T, NT: Single-component, pourable, +25%t and -25% movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.

3. EXECUTION

3.1 Sleeve Installation

.1 Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

.2 Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

.1 Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.

.2 Cut sleeves to length for mounting flush with both surfaces.

.1 Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 50 mm (2 inches) above finished floor level.

.3 Using grout or silicone sealant, seal space outside of sleeves in slabs and walls without sleeve-seal system.

.3 Install sleeves for pipes passing through interior partitions.

.1 Cut sleeves to length for mounting flush with both surfaces.

.2 Install sleeves that are large enough to provide 6 mm (1/4-inch) annular clear space between sleeve and pipe or pipe insulation.

.3 Seal annular space between sleeve and piping or piping insulation; use sealants appropriate for size, depth, and location of joint.

.4 Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke-Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 07 84 00.

3.2 Stack-Sleeve-Fitting Installation

.1 Install stack-sleeve fittings in new slabs as slabs are constructed.

.1 Install fittings that are large enough to provide 6 mm (1/4-inch) annular clear space between sleeve and pipe or pipe insulation.

.2 Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 07 62 00.

.3 Install section of cast-iron soil pipe to extend sleeve to 75 mm (3 inches) above finished floor level.

.4 Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

.5 Using waterproof silicone sealant, seal space between top hub of stack-sleeve fitting and pipe.

.2 Fire-Resistance-Rated, Horizontal Assembly, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping specified in Section 07 84 00.

3.3 Sleeve-Seal-System Installation

.1 Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

.2 Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal-system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 Sleeve-Seal-Fitting Installation

.1 Install sleeve-seal fittings as new walls and slabs are constructed.

.2 Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

.3 Secure nailing flanges to concrete forms.

.4 Using grout or silicone sealant, seal space around outside of sleeve-seal fittings.

3.5 Field Quality Control

.1 Perform the following tests and inspections:

.1 Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.

.2 Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

3.6 Sleeve and Sleeve-Seal Schedule

.1 Use sleeves and sleeve seals for the following piping-penetration applications:

.1 Exterior Concrete Walls Above Grade:

.1 Steel pipe sleeves with grout or silicone seal.

.2 Exterior Concrete Walls Below Grade:

.1 Steel pipe sleeves with modular sleeve-seal system.

.1 Select sleeve size to allow for annular clear space between piping and sleeve for installing sleeve-seal system.

.3 Concrete Slabs-on-Grade:

.1 Steel pipe sleeves with sleeve-seal system.

.1 Select sleeve size to allow for annular clear space between piping and sleeve for installing sleeve-seal system.

.4 Concrete Slabs Above Grade:

.1 Steel pipe sleeves with grout or silicone.

.5 Interior Partitions:

.1 Steel pipe sleeves with grout or silicone for non-fire rated walls.

.2 Steel pipe sleeves with fire stop material for fire rated walls.

3.7 Closeout Activities

.1 Provide in accordance with Section 01 78 00.

END OF SECTION

THERMOMETERS AND PRESSURE GAUGES - PIPING SYSTEMS

1. GENERAL

1.1 Related Requirements

.1 Section 23 21 23 - Hydronic Pumps.

1.2 References

.1 American Society of Mechanical Engineers (ASME):

.1 ASME B40.100, Pressure Gauges and Gauge Attachments.

.2 ASME B40.200, Thermometers, Direct Reading and Remote Reading.

1.3 Action and Informational Submittals

.1 Submit Shop Drawings and product data.

.2 Submit manufacturer's product data for following items:

.1 Thermometers.

.2 Pressure gauges.

.3 Stop cocks.

.4 Wells.

2. PRODUCTS

2.1 General

.1 See Section 40 91 01.

.2 Design point to be at mid-point of scale or range.

2.2 Thermometers

.1 Dial Thermometers: 75 mm diameter dial in drawn steel case, bimetallic helix actuated, brass separable socket of flange and bushing, glass cover, adjustable pointer.

2.3 Thermometer Well

.1 Stainless steel suitable for stem type thermometer with gasket and cap except in potable water and open systems, in which case brass type shall be used.

2.4 Pressure Gauges

.1 100 mm diameter, drawn steel case, phosphor bronze bourdon tube, brass movement, extruded brass socket, 1% midscale accuracy, front calibration adjustment, black figures on

white background. Provide gauge cock and syphon for steam service, pulsating damper and pet cock for water service.

3. EXECUTION

3.1 General

.1 Install so they can be easily read from floor or platform. If this cannot be accomplished, install remote reading units.

.2 Install between equipment and first fitting or valve.

.3 Select gauges so that normal operating point is approximately mid-point of instrument range.

3.2 Thermometers

.1 Install in wells on piping. Provide heat conductive material inside well.

.2 Install in locations as indicated on Drawings and:

.1 Water to glycol heat exchanger supply and return for both source and load side.

.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 PRVs.

.3 Upstream and downstream of strainers.

.4 Inlet and outlet of liquid side of heat exchangers.

.5 In other locations as indicated.

.2 Use extensions where pressure gauges are installed through insulation.

3.4 Nameplates

.1 Install engraved lamacoid nameplate, identifying medium.

END OF SECTION

VALVES - BRONZE

1. GENERAL

1.1 Description

.1 For additional information, refer to Section 21 05 01 - Common Work Results for Mechanical and Division 1 - General Conditions of the Construction Contract.

.2 For a list of applicable codes and standards, refer to Section 21 05 01 - Common Work Results for Mechanical.

.3 The Construction Contractor shall be responsible for coordinating all aspects of this Work.

.4 Locations of equipment, ductwork, pipework, and all associated appurtenances indicated on the Drawings are approximate only. The Construction Contractor is responsible for checking and coordinating the locations of equipment, ductwork, pipework, and all associated appurtenances and shall make any necessary adjustments in positions to conform with the architectural features, other services, symmetry, and lighting arrangements.

1.2 Scope of Work

.1 The Scope of Work for this Section includes, but is not limited to, the following:

.1 Materials and procedures for the provision and installation of bronze valves to domestic water and hydronic pipework.

1.3 Related Work

.1 This Section may not contain all materials, equipment and requirements required for the completion of this project. This Section is to be read in conjunction with the remaining Sections of Division 21, 22 and 23 all related works.

.2 Division 1 forms an integral part of Divisions 21, 22 and 23.

1.4 References

.1 Except as specified herein, the latest edition of the standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

.2 In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears.

.3 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME):

.1 ANSI/ASME B1.20.1, Pipe Threads, General Purpose (Inch).

.2 ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.

.4 ASTM International:

.1 ASTM A276, Standard Specification for Stainless Steel Bars and Shapes.

.2 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.

.3 ASTM B283, Standard Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).

.4 ASTM B505/B505M, Standard Specification for Copper Alloy Continuous Castings.

.5 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):

.1 MSS-SP-25, Standard Marking System for Valves, Fittings, Flanges and Unions.

.2 MSS-SP-80, Bronze Gate Globe, Angle and Check Valves.

1.5 Action and Informational Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical and Section 01 33 00 - Submittal Procedures for submission requirements.

.2 Product Data: Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish, and limitations.

.3 Submit copies of WHMIS SDS - Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

1.6 Closeout Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical, Section 01 33 00 - Submittal Procedures, and Section 01 78 00 - Closeout Submittals for submission requirements.

1.7 Delivery, Storage and Handling

.1 Shipping:

.1 All equipment, material and spare parts shall be shipped, stored, handled, and installed in such a manner as not to degrade quality, serviceability, or appearance. Equipment and material warranties shall not be voided by actions of the Construction Contractor.

.2 Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

.3 Pack spare parts in containers bearing labels clearly designated contents and pieces of equipment for which intended.

.4 Deliver spare parts at same time as related equipment. Deliver to the City after completion of Work.

.2 Receiving:

.1 All equipment, material and spare parts shall be delivered to the Site in original packages or containers bearing the manufacturer's labels and product identification.

.2 Inspect for damage and correctness, and inventory items, upon delivery to Site.

.3 Store equipment, material and spare parts protected for the weather, humidity and temperature variations, dirt and dust or other contaminants. Store and safeguard in accordance with Manufacturer's recommendations.

1.8 Quality Assurance

.1 Performance Requirements:

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

2. PRODUCTS

2.1 Materials

.1 Valves:

.1 Except for specialty valves, to be single manufacturer.

.2 Products to have CRN registration numbers.

.2 End Connections:

.1 Connection into adjacent piping/tubing:

.1 Steel pipe systems: screwed ends to ANSI/ASME B1.20.1.

.2 Copper tube systems: solder ends or grooved ends to ANSI/ASME B16.18.

2.2 Ball Valves:

.1 65 mm and under:

.1 Body and cap: cast high tensile bronze to ASTM B 62.

.2 Pressure rating: Class150.

.3 Connections: screwed ends to ANSI B1.20.1 and with hexagonal shoulders.

.4 Stem: tamperproof ball drive.

.5 Stem packing nut: external to body.

.6 Ball and seat: replaceable chrome plated brass ball and PTFE seats.

.7 Stem seal: PTFE with external packing nut.

.8 Operator: removable steel lever handle.

2.3 Check Valves

.1 65 mm and under, swing type, bronze disc, Class 125:

.1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.

.2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: re-grindable.

3. EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.

3.3 Cleaning

.1 Remove surplus materials, excess materials, rubbish, tools, and equipment.

END OF SECTION

VALVES - CAST IRON

1. GENERAL

1.1 Description

.1 For additional information, refer to Section 21 05 01 - Common Work Results for Mechanical and Division 1 - General Conditions of the Construction Contract.

.2 For a list of applicable codes and standards, refer to Section 21 05 01 - Common Work Results for Mechanical.

.3 The Construction Contractor shall be responsible for coordinating all aspects of this Work.

.4 Locations of equipment, ductwork, pipework, and all associated appurtenances indicated on the Drawings are approximate only. The Construction Contractor is responsible for checking and coordinating the locations of equipment, ductwork, pipework, and all associated appurtenances and shall make any necessary adjustments in positions to conform with the architectural features, other services, symmetry, clearances, and lighting arrangements.

1.2 Scope of Work

.1 The Scope of Work for this Section includes, but is not limited to, the following:

.1 Materials and procedures for the provision and installation of cast iron valves.

1.3 Related Work

.1 This Section may not contain all materials, equipment and requirements required for the completion of this project. This Section is to be read in conjunction with the remaining Sections of Division 21, 22 and 23 any and all related works.

.2 Division 1 forms an integral part of Divisions 21, 22 and 23.

1.4 References

.1 Except as specified herein, the latest edition of the standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

.2 In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears.

.3 American Society of Mechanical Engineers (ASME):

.1 ASME B16.1, Cast Iron Pipe Flanges and Flanged Fittings.

.4 ASTM International Inc.:

.1 ASTM A49, Standard Specification for Heat-Treated Carbon Steel Joint Bars, Microalloyed Joint Bars, and Forged Carbon Steel Compromise Joint Bars.

.2 ASTM A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

.3 ASTM A536, Standard Specification for Ductile Iron Castings.

.4 ASTM B61, Standard Specification for Steam or Valve Bronze Castings.

.5 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.

.6 ASTM B85/B 85M, Standard Specification for Aluminum-Alloy Die Castings.

.7 ASTM B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.5 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):

.1 MSS SP-61, Pressure Testing of Steel Valves.

.2 MSS SP-70, Grey Iron Gate Valves, Flanged and Threaded Ends.

1.5 Action and Informational Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical and Section 01 33 00 - Submittal Procedures for submission requirements.

.2 Product Data: Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Submit copies of WHMIS SDS - Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

1.6 Closeout Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical, Section 01 33 00 - Submittal Procedures, and Section 01 78 00 - Closeout Submittals for submission requirements.

1.7 Delivery, Storage and Handling

.1 Shipping:

.1 All equipment, material and spare parts shall be shipped, stored, handled, and installed in such a manner as not to degrade quality, serviceability, or appearance. Equipment and material warranties shall not be voided by actions of the Construction Contractor.

.2 Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

.3 Pack spare parts in containers bearing labels clearly designated contents and pieces of equipment for which intended.

.4 Deliver spare parts at same time as pertaining equipment. Deliver to the City after completion of Work.

.2 Receiving:

.1 All equipment, material and spare parts shall be delivered to the Site in original packages or containers bearing the manufacturer's labels and product identification.

.2 Inspect for damage and correctness, and inventory items, upon delivery to Site.

.3 Store equipment, material and spare parts protected for the weather, humidity and temperature variations, dirt and dust or other contaminants. Store and safeguard in accordance with Manufacturer's recommendations.

1.8 Quality Assurance

.1 Performance Requirements:

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

2. PRODUCTS

2.1 Material

.1 Valves:

.1 Except for specialty valves, to be of single manufacturer.

.2 Standard specifications:

.1 Gate valves: MSS SP-70.

.2 Globe valves: MSS SP-85.

.3 Check valves: MSS SP-71.

.3 Requirements common to valves, unless specified otherwise:

.1 Body, bonnet: cast iron to ASTM B 209 Class B.

.2 Connections: flanged ends with flat face to ANSI B16.1.

.3 Inspection and pressure testing: to MSS SP-82.

.4 Bonnet gasket: non-asbestos.

.5 Stem: to have precision-machined Acme or 60-degree V threads, top screwed for handwheel nut.

.6 Stuffing box: non-galling two-piece ball-jointed packing gland, gland bolts and nuts.

.7 Gland packing: non-asbestos.

.8 Handwheel: die-cast aluminum alloy to ASTM B 85/B 85M or malleable iron to ASTM A 49. Nut of bronze to ASTM B 62.

.9 Identification tag: with catalogue number, size, other pertinent data.

.4 All products to have CRN registration numbers.

2.2 Gate Valves

.1 Larger than 65 mm, other than mechanical rooms.

.1 Non-rising stem, inside screw, bronze trim, solid wedge disc:

.1 Body and multiple-bolted bonnet: full length disc guides designed to ensure correct re-assembly, Class 125.

.2 Disc: solid offset taper wedge, bronze to ASTM B 62.

.3 Seat rings: renewable bronze to ASTM B 62, screwed into body.

.4 Stem: bronze to ASTM B 62.

.2 Larger than 65 mm, in mechanical rooms and Scale Pit:

.1 Outside screw and yoke (OS&Y), bronze trim, solid wedge disc:

.1 Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, yoke, yoke hub, yoke sleeve and nut. Class 125.

.2 Disc: solid offset taper wedge, bronze to ASTM B 62 up to 80 mm, cast iron with bronze disc rings on other sizes, secured to stem through integral forged T-head disc-stem connection.

.3 Seat rings: renewable bronze screwed into body.

.4 Stem: nickel-plated steel or manganese-bronze.

.1 For Scale Pit: Extended stem, 600 mm or as required to suit the application.

2.3 Check Valves

.1 Swing check valves, Class 125:

.1 Body and bolted cover: with tapped and plugged opening on each side for hinge pin. Grooved or flanged ends: plain faced with smooth finish.

.1 Over 65 mm cast iron to ASTM A 126 Class B.

.2 Ratings:

.2 Larger than 65 mm 860 kPa steam; 1.4 MPa CWP.

.1 Disc: rotating for extended life.

.1 Up to 150 mm: bronze to ASTM B 62.

.2 Seat rings: renewable bronze to ASTM B 62 screwed into body.

.3 Hinge pin, bushings: renewable bronze to ASTM B 62 or stainless steel.

3. EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Install rising stem valves in upright position with stem above horizontal.

3.3 Cleaning

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1. GENERAL

1.1 Related Requirements

.1 Section 21 05 01 - Common Work Results for Mechanical.

1.2 References

.1 American Society of Mechanical Engineers (ASME):

.1 ASME B31.3, Process Piping.

.2 American Society for Testing and Materials (ASTM) International:

.1 ASTM A125-1996(2007), Standard Specification for Steel Springs, Helical, Heat-Treated.

.2 ASTM A307, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.

.3 ASTM A563, Standard Specification for Carbon and Alloy Steel Nuts.

.3 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS):

.1 MSS SP 58, Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation.

.2 MSS SP 69, Pipe Hangers and Supports - Selection and Application.

.3 MSS SP 89, Pipe Hangers and Supports - Fabrication and Installation Practices.

.4 Underwriter's Laboratories of Canada (ULC).

1.3 Action and Informational Submittals

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit Shop Drawings for:

.1 Bases, hangers and supports.

1.4 Closeout Submittals

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

1.5 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 01 61 00 – Materials and Equipment and with manufacturer's written instructions.

2. PRODUCTS

2.1 System Description

.1 Design Requirements:

.1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.

.2 Base maximum load ratings on allowable stresses prescribed by ASME B31.3 or MSS SP 58.

.3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.

.4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.

.5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP 58.

2.2 General

.1 Fabricate hangers, supports and sway braces in accordance with MSS SP 58. ANSI B31.1.

.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.3 Pipe Hangers

.1 Finishes:

.1 Piping above floor slab:

.1 Pipe hangers and supports: galvanized after manufacture.

.2 Use hot dipped galvanizing process.

.3 Ensure steel hangers in contact with copper piping are copper plated.

.2 Piping below floor slab:

.1 Pipe hangers and supports: stainless steel.

.2 Upper attachment structural: suspension from lower flange of I-Beam:

.1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.

.1 Rod: 9 mm UL listed.

.2 Cold piping NPS 2 1/2 or larger, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, ULc listed to MSS-SP 58and MSS-SP 69.

.3 Upper attachment structural: suspension from upper flange of I-Beam:

.1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, ULc listed to MSS SP 69.

.2 Cold piping NPS 2 1/2 or larger, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut ULc listed.

.4 Upper attachment to concrete:

.1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.

.2 Concrete inserts: wedge shaped body with knockout protector plate, ULc listed, to MSS SP 69.

.5 Hanger rods: threaded rod material to MSS SP 58:

.1 Ensure that hanger rods are subject to tensile loading only.

.2 Provide linkages where lateral or axial movement of pipework is anticipated.

.6 Pipe attachments: material to MSS SP 58:

.1 Attachments for steel piping: carbon steel galvanized.

.2 Attachments for copper piping: copper plated black steel.

.3 Use insulation shields for hot pipework.

.4 Oversize pipe hangers and supports.

.7 Adjustable clevis: material to MSS SP 69 ULc listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.

.1 Ensure "U" has hole in bottom for riveting to insulation shields.

.8 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP 69.

.9 U-bolts: carbon steel to MSS SP 69 with 2 nuts at each end to ASTM A 563.

.1 Finishes for steel pipework: galvanized.

.2 Finishes for copper pipework: galvanized with formed portion plastic coated.

2.4 Riser Clamps

.1 Steel or cast iron pipe: galvanized carbon steel to MSS SP 58, type 42, UL listed.

.2 Copper pipe: carbon steel copper plated to MSS SP 58, type 42.

.3 Bolts: to ASTM A 307.

.4 Nuts: to ASTM A 563.

2.5 Insulation Protection Shields

.1 Insulated cold piping:

.1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP 69, galvanized sheet carbon steel. Length designed for maximum 3 m span.

.2 Insulated hot piping:

.1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP 69.

2.6 Constant Support Spring Hangers

.1 Springs: alloy steel to ASTM A 125, shot peened, magnetic particle inspected, with plus or minus 5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR).

.2 Load adjustability: 10% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.

.3 Provide upper and lower factory set travel stops.

.4 Provide load adjustment scale for field adjustments.

.5 Total travel to be actual travel plus 20%. Difference between total travel and actual travel 25 mm minimum.

.6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.7 Variable Support Spring Hangers

.1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.

.2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with two (2) springs in series in single casing.

.3 Variable spring hanger complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.

.4 Steel alloy springs: to ASTM A 125, shot peened, magnetic particle inspected, with plus or minus 5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.8 Equipment Supports

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 50 00 – Metal Fabrications. Submit calculations with Shop Drawings.

2.9 House-Keeping Pads

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

.2 Concrete: to Section 03 30 00 - Cast-in-Place Concrete.

3. EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Install in accordance with:

.1 Manufacturer's instructions and recommendations.

.2 Vibration Control Devices:

.1 Install on piping systems at pumps, boilers, chillers, cooling towers, and as indicated.

.3 Clamps on riser piping:

.1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.

.2 Bolt-tightening torques to industry standards.

.3 Steel pipes: install below coupling or shear lugs welded to pipe.

.4 Cast iron pipes: install below joint.

.4 Clevis plates:

.1 Attach to concrete with four (4) minimum concrete inserts, one (1) at each corner.

.5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

.6 Use variable support spring hangers where:

.1 Transfer of load to adjacent piping or to connected equipment is not critical.

.2 Variation in supporting effect does not exceed 25% of total load.

3.3 Hanger Spacing

.1 Plumbing piping: to Canadian Plumbing Code.

.2 Fire protection: to applicable fire code.

.3 Copper piping: up to NPS 1/2: every 1.5 m.

.4 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.

.5 Within 300 mm of each elbow.

.6 Maximum spacing:

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

.7 Pipework larger than NPS 12: to MSS SP 69.

3.4 Hanger Installation

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

.2 Adjust hangers to equalize load.

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

3.5 Horizontal Movement

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

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

3.6 Final Adjustment

.1 Adjust hangers and supports:

.1 Ensure that rod is vertical under operating conditions.

.2 Equalize loads.

.2 Adjustable clevis:

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

.2 Tighten upper nut after adjustment.

.3 C-clamps:

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

.4 Beam clamps:

.1 Hammer jaw firmly against underside of beam.

3.7 Cleaning

.1 Remove surplus materials, excess materials, rubbish, tools, and equipment.

END OF SECTION

MECHANICAL IDENTIFICATION

1. GENERAL

1.1 Description

.1 For additional information, refer to Section 21 05 01 - Common Work Results for Mechanical and Division 1 - General Conditions of the Construction Contract.

.2 For a list of applicable codes and standards, refer to Section 21 05 01 - Common Work Results for Mechanical.

.3 The Construction Contractor shall be responsible for coordinating all aspects of this Work.

.4 Locations of equipment, ductwork, pipework, and all associated appurtenances indicated on the Drawings are approximate only. The Construction Contractor is responsible for checking and coordinating the locations of equipment, ductwork, pipework, and all associated appurtenances and shall make any necessary adjustments in positions to conform with the architectural features, other services, symmetry, clearances, and lighting arrangements.

1.2 Scope of Work

.1 The Scope of Work for this Section includes, but is not limited to, the following:

.1 Materials and procedures for the provision and installation of identification signs and arrows related to the mechanical systems.

1.3 Related Work

.1 This Section may not contain all materials, equipment and requirements required for the completion of this project. This Section is to be read in conjunction with Section 09 91 13 - Field-Applied Maintenance and Corrosion Protection Coatings and the remaining Sections of Division 21, 22 and 23 and all related works.

.2 Division 1 forms an integral part of Divisions 21, 22 and 23.

1.4 References

.1 Except as specified herein, the latest edition of the standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

.2 In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears.

.3 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-24.3, Standard for Pipe Identification.

1.5 Action and Informational Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical and Section 01 33 00 - Submittal Procedures for submission requirements.

.2 Product Data: Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Submit copies of WHMIS SDS - Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

.4 Samples:

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

.2 Samples to include nameplates, labels, tags, lists of proposed legends.

1.6 Closeout Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical, Section 01 33 00 - Submittal Procedures, and Section 01 78 00 - Closeout Submittals for submission requirements.

1.7 Delivery, Storage and Handling

.1 Shipping:

.1 All equipment, material and spare parts shall be shipped, stored, handled, and installed in such a manner as not to degrade quality, serviceability, or appearance. Equipment and material warranties shall not be voided by actions of the Construction Contractor.

.2 Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

.3 Pack spare parts in containers bearing labels clearly designated contents and pieces of equipment for which intended.

.4 Deliver spare parts at same time as pertaining equipment. Deliver to the City after completion of Work.

.2 Receiving:

.1 All equipment, material and spare parts shall be delivered to the Site in original packages or containers bearing the manufacturer's labels and product identification.

.2 Inspect for damage and correctness, and inventory items, upon delivery to Site.

.3 Store equipment, material and spare parts protected for the weather, humidity and temperature variations, dirt and dust or other contaminants. Store and safeguard in accordance with Manufacturer's recommendations.

2. PRODUCTS

2.1 Manufacturer's Equipment Nameplates

.1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.

.2 Lettering and numbers raised or recessed.

.3 Information to include, as appropriate:

.1 Equipment: manufacturer's name, model, size, serial number, capacity.

.2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 System Nameplates

.1 Colours:

.1 Hazardous: red letters, white background.

.2 Elsewhere: black letters, white background.

.2 Construction:

.1 3 mm thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:

.1 Conform to following table:

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

.2 Use maximum of 25 characters per line.

.3 Locations:

.1 Pressure sensors, remote switches: use size #2.

.2 Terminal cabinets, control panels: use size # 5.

.3 Equipment in Mechanical Rooms: use size # 9.

.4 Equipment elsewhere: use size # 7.

2.3 Identification of Piping Systems

.1 Identify piping with labels, colour bands, and flow arrows.

.1 For pipe up to and including 150 mm diameter, Smillie McAdams Summerlin Ltd. "Coil-Mark", consisting of coloured, coiled, semi-rigid vinyl plastic of a length to wrap completely around the pipe, and indoor/outdoor type vinyl ink lettering and directional arrows and for pipe larger than 150 mm O.D., the markers are saddle style with two rows of wording and are installed using nylon tie wraps provided with the marker or approved alternative.

.2 Use pictograms as required by WHMIS regulations.

.3 Paint in accordance with Section 09 91 13 - Field-Applied Maintenance and Corrosion Protection Coatings.

.2 Colours and Legends:

.1 Colours for legends and arrow as per the following table:

Background Colour	Legend/Arrows
Yellow	Black
Green	White
Red	White

.2 Background colour markings and legends for piping systems:

Contents	Background Colour Marking	Legend
Condensate	Yellow	Condensate
Domestic Cold Water Supply	Green	Dom. CWS
Domestic Hot Water Supply	Green	Dom. HW Supply
Domestic Hot Water Recirculation	Green	Dom. HW Circ.
Process Water	Yellow	Process Water
Hydronic Hot Water	Green	HHW
Glycol Supply	Green	GS
Glycol Return	Green	GR
Refrigeration	Yellow	R410a
Sanitary	Green	San.
Sanitary Vent	Green	San. Vent

.3 Valves

.1 Provide coloured, 3 mm thick, 40 mm square, 2-ply laminated plastic with bevelled edges with 12 mm high text, red-white, green-white, yellow-black, etc., to match the piping classification colour, each complete with a 3.2 mm diameter by 100 mm long brass plated steel bead chain, and four lines of engraved maximum size identification wording, i.e.:

VALVE V12
200 mm

.2 Provide neat, typewritten directories, giving valve number, services and location. Frame one copy under glass for wall mounting as directed, second copy to be forwarded to the City. Include copies in O&M Manuals.

2.4 Identification of Ductwork

.1 Ductwork:

.1 All ductwork in to be identified as follows, complete with directional arrows:

Exhaust Air: Exh. Air.
Relief Air: Relief Air
Return Air: R.A.
Supply Air: S.A.

.2 Identify the usage of duct access panels with coloured 3 mm thick, 25 mm x 40 mm square, 2-ply laminated plastic with bevelled edges with 12 mm high text. Apply lamicoids conforming to the following schedule.

Service	Background Colour	Text Colour	Text
Cleaning and service access	Yellow	Black	C.A.
Controls, including heat sensors	Black	White	C.
Dampers (balance & control)	Blue	White	D
Fire dampers	Red	White	F.D.
Smoke dampers and detectors	Red	White	S.D.

2.5 Identification of Control Systems

.1 Mechanical Control Systems:

.1 Identify all systems, equipment, components, controls, sensors conduit pull boxes, terminal boxes and junction boxes with system nameplates specified in this Section.

.2 Inscriptions to include function and (where appropriate) fail-safe position.

3. EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Timing

.1 Provide identification only after painting specified Section 09 91 00 - Painting has been completed.

3.3 Installation

.1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.

.2 Provide identification only after painting specified Section 09 91 00 - Painting has been completed.

.3 Provide ULC and/or CSA registration plates as required by respective agency.

3.4 Nameplates

.1 Locations:

.1 In conspicuous location to facilitate easy reading and identification from operating floor.

.2 Standoffs:

.1 Provide for nameplates on hot and/or insulated surfaces.

.3 Protection:

.1 Do not paint, insulate or cover.

3.5 Location of Identification on Piping and Ductwork Systems

.1 Provide identification at 3 m maximum intervals.

.2 Adjacent to each change in direction.

.3 At least once in each small room through which piping or ductwork passes.

.4 On both sides of visual obstruction or where run is difficult to follow.

.5 On both sides of separations such as walls, floors, partitions.

.6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.

.7 At beginning and end points of each run and at each piece of equipment in run.

.8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.

.9 Identification easily and accurately readable from usual operating areas and from access points.

.1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.6 Valves, Controllers

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

.2 Install one (1) copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Contract Administrator. Provide one (1) copy (reduced in size if required) in each operating and maintenance manual.

.3 Number valves in each system consecutively.

3.7 Cleaning

.1 Remove surplus materials, excess materials, rubbish, tools, and equipment.

END OF SECTION

TESTING

1. GENERAL

1.1 Scope

.1 Test domestic water piping.

.2 Test sanitary sewer piping.

.3 Test low velocity ducts.

.4 Test refrigeration piping.

.5 Performance testing of equipment.

.6 Manufacturer's start-up of equipment.

1.2 Scope of Work

.1 The Scope of Work for this Section includes, but is not limited to, the following:

.1 Materials and procedures for the testing of systems installed under Division 10, 21, 22, and 23.

1.3 Related Work

.1 This Section may not contain all materials, equipment and requirements required for the completion of this project. This Section is to be read in conjunction with the remaining Sections of Division 21, 22 and 23 and all related works.

.2 Division 1 forms an integral part of Division 21, 22 and 23.

1.4 Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical and Section 01 33 00 - Submittal Procedures for submission requirements.

.2 Product Data: Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Submit copies of WHMIS SDS - Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

.4 Obtain certificates of approval, acceptance, and comply with current rules and regulations from Authorities Having Jurisdiction and include in Operating and Maintenance Manuals.

.5 Perform tests as specified and upon completion of mechanical installation. Provide certification of tests with detailed data as required. Itemise each test as to time performed and personnel responsible. Include in Operating and Maintenance Manuals.

1.5 Closeout Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical, Section 01 33 00 - Submittal Procedures, and Section 01 78 00 - Closeout Submittals for submission requirements.

1.6 Delivery, Storage and Handling

.1 Shipping:

.1 All equipment, material and spare parts shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability, or appearance. Equipment and material warranties shall not be voided by actions of the Construction Contractor.

.2 Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

.3 Pack spare parts in containers bearing labels clearly designated contents and pieces of equipment for which intended.

.4 Deliver spare parts at same time as pertaining equipment. Deliver to the City after completion of Work.

.2 Receiving:

.1 All equipment, material and spare parts shall be delivered to the Site in original packages or containers bearing the manufacturer's labels and product identification.

.2 Inspect for damage and correctness, and inventory items, upon delivery to Site.

.3 Store equipment, material and spare parts protected for the weather, humidity and temperature variations, dirt and dust or other contaminants. Store and safeguard in accordance with Manufacturer's recommendations.

1.7 Quality Assurance

.1 Performance Requirements:

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

.2 Test equipment and material where required by specification or Authority Having Jurisdiction to demonstrate its proper and safe operation.

.3 Test procedures in accordance with the current applicable portions of ASME, ASHRAE, CSA, and other recognised test codes as far as field conditions permit.

.4 Perform tests on Site to the satisfaction of the Contract Administrator.

.5 Piping, fixtures or equipment shall not be concealed or covered until inspected and approved by the Contract Administrator. Provide ample written notice (two (2) working days) to the Contract Administrator before tests.

.6 Co-ordinate with Contract Administrator at start of project, those tests that will require witnessing by the Contract Administrator.

.7 Use factory trained representatives and submit manufacturer's check sheets for starting the following specialty equipment.

.1 Air handling/make up air units.

.2 Pumps.

.3 Variable speed drive units.

.4 Air conditioning equipment.

.5 Control components.

.6 Chemical cleaning and treatment.

.7 Domestic water heaters.

.8 Prior to starting, testing, balancing, adjusting and cleaning processes, verify with Contract Administrator any tests required to be witnessed. Provide sufficient notice to Contract Administrator prior to commencement of procedures.

.9 Contract Administrator shall be allowed to witness any testing, adjusting, starting, balancing and cleaning procedures.

.10 Assume all costs associated with starting and testing, including the supply of testing or cleaning medium.

.11 Prior to starting equipment or systems, secure and review manufacturer's installation, operation and starting instructions. Read in conjunction with procedures defined herein.

.12 Use manufacturer's or supplier's starting personnel where required to ensure integrity of manufacturer's warranty.

.13 Compare installations to published manufacturer's data and record discrepancies. Items proving detrimental to equipment performance shall be corrected prior to equipment starting.

.14 Some processes involved in starting procedures defined in this section may be duplications of authorities' verification. To facilitate expedient completion of project, arrange for authorities to assist or witness these procedures. (Gas inspectors, boiler and pressure vessels inspections etc.)

.15 All starting, testing procedures shall be in accordance with applicable portions of the latest, current ASME, ASHRAE, AABC, CSA, NFPA, SMACNA, ASTM and ASPE codes and standards.

.16 Personnel involved in starting, testing, balancing and adjusting procedures shall be experienced in the design and operation of mechanical equipment and systems being checked and shall be able to interpret results of the reading and tests.

.17 Assume all liabilities associated with starting, testing and balancing procedures.

1.8 Liability

.1 Take charge of plant during tests, assume responsibility for damages in event of injury to personnel, building or equipment and bear costs for liability, repairs, and restoration in this connection.

2. PRODUCTS (NOT USED)

3. EXECUTION

3.1 Pressure Tests

.1 Provide equipment, materials and labour for tests and pay expenses. Use test instruments from approved laboratory or manufacturer and furnish certificate showing degree of accuracy. Install permanent gauges and thermometers used for tests just prior to tests to avoid possible changes in calibration.

.2 Carry out tests for eight-hour period and maintain pressure with no appreciable pressure drop. Where leakage occurs, repair and re-test and pay necessary costs for re-witnessing.

.3 Drainage Systems: Test by filling with water to produce water pressure to 30 kPa minimum and 62 kPa maximum.

.4 Water Piping: Test to 1-1/2 times maximum working pressure or 1033 kPa, whichever is greater, water pressure measured at system low point.

.5 Ducts: Test ducts as per current edition of SMACNA Manual.

.6 Refrigerant Piping: Test refrigerant piping for leakage and dehydrate in accordance with requirements of the ASHRAE Handbook - Refrigeration.

.7 Check systems during application of test pressure including visual check for leakage of water test medium, soap bubble test for air.

.8 During heating and cooling piping system tests, check linear expansion at elbows, U bends, expansion joints and offsets for proper clearance.

.9 When using water as test medium for system not using water, evacuate and dehydrate the piping and certify the lines are dry. Use agency specialising in this type of work.

.10 Should tests indicate defective work or variance with specified requirements, make changes immediately to correct the defects. Correct leaks by re-making joints in screwed fittings, cutting out and re-welding welded joints, re-making joints in copper lines. Do not caulk.

3.2 General

.1 Conduct performance tests to demonstrate equipment and systems meet specified requirements after mechanical installations are completed and pressure tested. Conduct tests as soon as conditions permit. Make changes, repairs, and adjustments required prior to operating tests.

.2 Meet with Division 23 manufacturers, suppliers, and other specialists as required to ensure all phases of work are properly co-ordinated prior to the commencement of each particular testing procedure. Establish all necessary manpower requirements.

.3 Operate and test motors and speed switches for correct wiring and sequences and direction of rotation. Check and record overload heaters in motor starters.

.4 Confirm voltages and operating amperages at full load.

.5 Failure to follow instruction pertaining to correct starting procedures may result in re-evaluation of equipment by an Independent Testing Agency selected by the City at Construction Contractor's expense. Should results reveal equipment has not been properly started, equipment may be rejected, removed from site, and replaced. Replacement equipment shall also be subject to full starting procedures, using same procedures specified on the originally installed equipment.

3.3 Procedures

.1 Procedures shall be identified in the following five (5) distinct phases:

.1 Pre-Starting: Visual inspection.

.2 Starting: Actual starting procedure.

.3 Post-Starting: Operational testing adjusting or balancing, and equipment run-in phase.

.4 Pre-Interim Acceptance of the Work: Final cleaning, re-testing, balancing and adjusting, and necessary maintenance.

.5 Post-Interim Acceptance of the Work: Repeat tests and fine-tuning resulting from corrective action of deficiency clean-up.

.2 Check specified and Shop Drawing data against installed data.

.3 Check the installation is as defined by Construction Contract Documents and as per manufacturer's recommendations including manufacturer's installation check sheets.

END OF SECTION

1. GENERAL

1.1 Scope

.1 Balance, adjust, and test air and water systems and equipment and submit reports in identical units to those shown on Construction Contract Drawings. Systems include but not limited to:

.1 Electrical Room ventilation system and room pressurization.

.2 Mechanical Room ventilation system.

.3 Fan Room ventilation system and room pressurization.

.4 Process area ventilation systems and room pressurization.

.5 Domestic hot water system.

.6 Constant-flow hydronic systems.

.7 Variable-flow hydronic systems.

.2 Construction Contractor shall prepare the facility for balancing.

1.2 Quality Assurance

.1 Work specified in this Section shall be performed by an Independent Agency specializing in this type of work, and paid by the Construction Contractor.

.2 Balancing (of both air and water systems) and sound level readings shall be performed by the same agency.

.3 Balancing procedures shall be in accordance with the latest, current requirements AABC, NEBB, SMACNA and ASHRAE Standards.

1.3 Site Visits

.1 Minimum of two (2) Site visits shall be made during construction to correspond with the general monthly site meetings held by the Construction Contractor. After each Site visit, a written report shall be submitted to the Construction Contractor and Contract Administrator. Site visits shall commence after the start of air and water distribution work and be spread over the construction period to the start of the balancing work.

.2 A review of the installation shall be made at the specified Site visit and any additional dampers or valves required for proper balance shall be reviewed with the Contract Administrator and the Construction Contractor.

.3 Allow two (2) visits to Site to adjust systems for seasonal changes and to check and reset fans and outlets during warranty. Co-ordinate time of visit with the City. Submit reports to Contract Administrator.

.4 Begin balancing after balancing preparation and after systems have been completed and are in full working order. Place systems and equipment into full operation and continue operation during each working day of balancing.

1.4 Balancing Plan

.1 The balancing contractor shall within two (2) weeks of the award of Construction Contract submit a draft balancing plan to the Commissioning Coordinator for inclusion in the draft commissioning plan.

.1 The balancing plan shall include but not be limited to:

.1 Descriptive Data: General description of each system including associated equipment and different operation cycles, listing of flow and terminal measurements to be performed and selection points for proposed sound measurements.

.2 Procedure Data: Procedures for converting test measurements to establish compliance with requirements, specify type of instrument to be used, method of instrument application (by sketch) and correction factors.

.3 Sample Forms: Form showing application of procedures to typical systems.

.4 Other details as required by the Commissioning Agency.

.2 The balancing contractor shall within one (1) week of the initial commissioning meeting author a definitive balancing plan implementing the necessary changes discussed at the initial commissioning meeting for resubmission to the Commissioning Coordinator. The balancing plan will be updated regularly by the balancing contractor and resubmitted to the Commissioning Coordinator as required by the Commissioning Coordinator.

1.5 Balance Report

.1 Submit electronic draft of balancing reports to Contract Administrator prior to final acceptance of project.

.2 Provide hard copies of final reports to Construction Contractor for inserting in the City's Operating and Maintenance Manuals.

.3 Provide electronics copies of final reports to Construction Contractor for inserting in the City's Operating and Maintenance Manuals. Copies shall be PDF format saved on a USB stick.

.4 Include types, serial number and dates of calibration of instruments in the reports.

1.6 System Data

.1 The following information shall be provided:

.1 Air Handling Equipment:

.1 Design Data:

.1 Total air flow rate.

.2 Fan total static pressure.

.3 System static pressure.

.4 Motor kW (hp), r/min, amps, volts, phase.

.5 Outside air flow rate L/s.

.6 Fan speed rpm.

.7 Fan power kW.

.8 Inlet and outlet, dry and wet bulb temperatures.

.2 Installation Data:

.1 Manufacturer and model.

.2 Size.

.3 Arrangement discharge and class.

.4 Motor type, kW, rpm, voltage, phase, cycles, and load amperage.

.5 Location and local identification data.

.3 Recorded Data:

.1 Air flow rate.

.2 Fan total static pressure.

.3 System static pressure.

.4 Fan r/min.

.5 Motor operating amperage.

.6 Inlet and outlet, dry and wet bulb temperatures.

.7 Duct Air Quantities: All mains supplying more than 10% of Volume, outside air and exhaust (maximum and minimum) major return air openings back to duct shafts.

.8 Duct sizes.

.9 Number of pressure readings.

.10 Sum of velocity measurements.

.11 Average velocity.

.12 Duct recorded air flow rate.

.13 Duct design air flow rate.

.2 Air Inlet and Outlets:

.1 Outlet identification location and designation.

.2 Manufacturers catalogue identification and type.

.3 Application factors.

.4 Design and recorded velocities.

.5 Design and recorded air flow rates.

.6 Deflector vane or diffuser cone settings.

.3 Pumps:

.1 Design Data:

.1 Fluid flow rate.

.2 Total head.

.3 kW, rpm, amps, volts, phase.

.2 Installation Data:

.1 Manufacturer and model.

.2 Size.

.3 Type drive.

.4 Motor type, kW, rpm, voltage, phase, and full load amperage.

.3 Recorded Data:

.1 Discharge and suction pressures (full flow and no flow).

.2 Operating head.

.3 Operating water flow rate (from pump curves if metering not provided).

.4 Motor operating amps (full flow and no flow).

.5 Speed (rpm).

.4 Expansion Tank:

.1 Design Data:

.1 Size.

.2 Capacity.

.3 Pressure rating.

.2 Installation Data:

.1 Manufacturer, size, capacity.

.2 Pressure reducing valve setting.

.3 Pressure relief valve setting.

.5 Heat exchangers:

.1 Design Data:

.1 Hot water side and glycol side:

.1 Fluid flow rate.

.2 Fluid pressure drop.

.3 Fluid inlet and outlet temperatures.

.2 Installation Data:

.1 Manufacturer and model.

.2 Size.

.3 Recorded Data:

.1 Hot water side and glycol side:

.1 Fluid flow rate.

.2 Fluid inlet and outlet pressures.

.3 Fluid inlet and outlet temperatures.

.6 Hydronic coils and Heaters:

.1 Design Data:

.1 Fluid flow rate.

.2 Fluid pressure drop.

.3 Fluid inlet and outlet temperatures.

.2 Installation Data:

.1 Manufacturer and model.

.2 Size.

.3 Motor type, kW, rpm, voltage, phase, cycles, and load amperage.

.3 Recorded Data:

.1 Fluid flow rate.

.2 Fluid inlet and outlet pressures.

.3 Fluid inlet and outlet temperatures.

2. PRODUCTS

2.1 Instruments

.1 Provide calibration histories for each instrument. Recalibration or use of other instruments may be requested when accuracy of readings is questionable.

3. EXECUTION

3.1 General Procedure

.1 Permanently mark, by stick-on labels, settings on valves, splitters, dampers, and other adjustment devices.

.2 Subsequent to correctional work, take measurements to verify balance has not been disrupted or that any such disruption has been rectified.

.3 Balancing shall be performed to the following accuracies:

.1	Air / liquid	terminal outlets	plus 10%
.2	Air / liquid	Fans/pumps and central equipment	plus 5%

3.2 Air System Procedure

.1 Perform balancing, adjusting and testing with building doors and windows in their normal operation position.

.2 The following procedure shall be adopted for central systems:

.1 Ensure dampers or volume control devices are in fully open position.

.2 Balance central apparatus to plus or minus 10% air flow.

.3 Balance branches, mains to plus or minus 10% air flow.

.4 Recheck central apparatus.

.5 Balance all terminal air outlets to plus or minus 10%.

.6 Rebalance central apparatus to plus or minus 5%.

.7 Recheck all air outlets.

.8 Perform acoustical measurements.

.9 Perform building pressurisation tests and measurements at minimum and maximum outdoor air damper positions of the main air unit(s).

.3 When balancing air outlets:

.1 Rough balance furthest outlets and then balance sequentially back to source.

.2 Fine balance furthest outlet back to source.

.4 Take static pressure readings and air supply temperature readings at ten (10) points on each air system.

.5 Make air quantity measurements in ducts by "Pitot Tube" traverse of entire cross sectional area. If readings are inconsistent across duct, relocate to two duct diameters or widths and re-do traverse.

.6 Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control only by duct internal devices such as dampers and splitters.

.7 Vary total system air quantities by adjustment of fan speeds. Vary branch air quantities by damper regulation.

.8 Where modulating dampers are provided, take measurements and balance at extreme conditions. (Balance variable volume systems at maximum air flow rate - full cooling, and at minimum air flow rate - full heating).

.9 The final balanced condition of each area shall include testing and adjusting of pressure conditions. Test and record building pressurisation levels in variable volume systems throughout full range of fan delivery rates, under both heating and cooling conditions. Full multi-storey building test pressure conditions at ground, intermediate and upper levels. Front doors, exits, elevator shafts, should be checked for air flow so that exterior conditions do not cause excessive or abnormal pressure conditions. Document abnormal building leakage conditions noted.

.10 Complete balancing to achieve positive building pressure of 5 Pa in the Mechanical and Electrical Rooms, and a negative pressure of 25 Pa in the blower room all relative to outdoors, measured with negligible outside wind velocity.

3.3 Balancing and Adjusting of Domestic Water Systems

.1 Adjust PRV on main line to 570 kPa maximum.

.2 Balance domestic hot water recirculating system piping to ensure flow from all points in the system. Ensure all hot and cold supply shut off valves are fully open.

3.4 Balancing and Adjusting of Hydronic Systems

.1 General:

.1 Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.

.2 Prepare schematic diagrams of systems' piping layouts.

.3 Prepare hydronic systems for testing and balancing as follows:

.1 Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.

.2 Piping is complete with terminals installed.

.3 Water treatment is complete.

.4 Systems are flushed, filled, and air purged.

.5 Strainers are pulled and cleaned.

.6 Control valves are functioning per the sequence of operation.

.7 Shutoff and balance valves have been verified to be 100% open.

.8 Pumps are started and proper rotation is verified.

.9 Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.

.10 Variable-frequency controllers' start-up is complete and safeties are verified.

.11 Suitable access to balancing devices and equipment is provided.

.12 Check liquid level in expansion tank.

.13 Check highest vent for adequate pressure.

.14 Check flow-control valves for proper position.

.15 Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

.16 Verify that motor starters are equipped with properly sized thermal protection.

.17 Check that air has been purged from the system.

.2 Procedures for Constant-Flow Hydronic Systems:

.1 Adjust pumps to deliver total design flow.

.1 Measure total water flow.

.1 Position valves for full flow through coils.

.2 Measure flow by main flow meter, if installed.

.3 If main flow meter is not installed, determine flow by pump total dynamic head (TDH) or exchanger pressure drop.

.2 Measure pump TDH as follows:

.1 Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.

.2 Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.

.3 Convert pressure to head and correct for differences in gage heights.

.4 Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.

.5 With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

.3 Monitor motor performance during procedures and do not operate motor in an overloaded condition.

.2 Adjust flow-measuring devices installed in mains and branches to design water flows.

.1 Measure flow in main and branch pipes.

.2 Adjust main and branch balance valves for design flow.

.3 Re-measure each main and branch after all have been adjusted.

.3 Adjust flow-measuring devices installed at terminals for each space to design water flows.

.1 Measure flow at terminals.

.2 Adjust each terminal to design flow.

.3 Re-measure each terminal after it is adjusted.

.4 Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.

.5 Perform temperature tests after flows have been balanced.

.4 For systems with pressure-independent valves at terminals:

.1 Measure differential pressure and verify that it is within manufacturer's specified range.

.2 Perform temperature tests after flows have been verified.

.5 For systems without pressure-independent valves or flow-measuring devices at terminals:

.1 Measure and balance coils by either coil pressure drop or temperature method.

.2 If balanced by coil pressure drop, perform temperature tests after flows have been verified.

.6 Verify final system conditions as follows:

.1 Re-measure and confirm that total water flow is within design.

.2 Re-measure final pumps' operating data, TDH, volts, amps, and static profile.

.3 Mark final settings.

.7 Verify that memory stops have been set.

.3 Procedures for Variable-Flow Hydronic Systems:

.1 Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals, and proceed as specified above for hydronic systems.

.2 Adjust the variable-flow hydronic system as follows:

.1 Verify that the differential-pressure sensor is located as indicated.

.2 Determine whether there is diversity in the system.

.3 For systems with no diversity:

.1 Adjust pumps to deliver total design flow.

.1 Measure total water flow.

.1 Position valves for full flow through coils.

.2 Measure flow by main flow meter, if installed.

.3 If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

.2 Measure pump TDH as follows:

.1 Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.

.2 Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.

.3 Convert pressure to head and correct for differences in gage heights.

.4 Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.

.5 With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

.3 Monitor motor performance during procedures and do not operate motor in an overloaded condition.

.2 Adjust flow-measuring devices installed in mains and branches to design water flows.

.1 Measure flow in main and branch pipes.

.2 Adjust main and branch balance valves for design flow.

.3 Re-measure each main and branch after all have been adjusted.

.3 Adjust flow-measuring devices installed at terminals for each space to design water flows.

.1 Measure flow at terminals.

.2 Adjust each terminal to design flow.

.3 Re-measure each terminal after it is adjusted.

.4 Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.

.5 Perform temperature tests after flows have been balanced.

.4 For systems with pressure-independent valves at terminals:

.1 Measure differential pressure and verify that it is within manufacturer's specified range.

.2 Perform temperature tests after flows have been verified.

.5 For systems without pressure-independent valves or flow-measuring devices at terminals:

.1 Measure and balance coils by either coil pressure drop or temperature method.

.2 If balanced by coil pressure drop, perform temperature tests after flows have been verified.

.6 Prior to verifying final system conditions, determine the system differential-pressure set point.

.7 If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hertz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.

.8 Mark final settings and verify that all memory stops have been set.

.9 Verify final system conditions as follows:

.1 Re-measure and confirm that total water flow is within design.

.2 Re-measure final pumps' operating data, TDH, volts, amps, and static profile.

.3 Mark final settings.

.10 Verify that memory stops have been set.

.4 For systems with diversity:

.1 Determine diversity factor.

.2 Simulate system diversity by closing required number of control valves, as approved by the design engineer.

.3 Adjust pumps to deliver total design flow.

.1 Measure total water flow.

.1 Position valves for full flow through coils.

.2 Measure flow by main flow meter, if installed.

.3 If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

.2 Measure pump TDH as follows:

.1 Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.

.2 Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.

.3 Convert pressure to head and correct for differences in gage heights.

.4 Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.

.5 With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

.3 Monitor motor performance during procedures and do not operate motor in an overloaded condition.

.4 Adjust flow-measuring devices installed in mains and branches to design water flows.

.1 Measure flow in main and branch pipes.

.2 Adjust main and branch balance valves for design flow.

.3 Re-measure each main and branch after all have been adjusted.

.5 Adjust flow-measuring devices installed at terminals for each space to design water flows.

.1 Measure flow at terminals.

.2 Adjust each terminal to design flow.

.3 Re-measure each terminal after it is adjusted.

.4 Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.

.5 Perform temperature tests after flows have been balanced.

.6 For systems with pressure-independent valves at terminals:

.1 Measure differential pressure, and verify that it is within manufacturer's specified range.

.2 Perform temperature tests after flows have been verified.

.7 For systems without pressure-independent valves or flow-measuring devices at terminals:

.1 Measure and balance coils by either coil pressure drop or temperature method.

.2 If balanced by coil pressure drop, perform temperature tests after flows have been verified.

.8 Open control valves that were shut. Close a sufficient number of control valves that were previously open to maintain diversity, and balance terminals that were just opened.

.9 Prior to verifying final system conditions, determine system differential-pressure set point.

.10 If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hertz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.

.11 Mark final settings and verify that memory stops have been set.

.12 Verify final system conditions as follows:

.1 Re-measure and confirm that total water flow is within design.

.2 Re-measure final pumps' operating data, TDH, volts, amps, and static profile.

.3 Mark final settings.

.13 Verify that memory stops have been set.

3.5 Balancing Report

.1 Submit draft copies of reports prior to final acceptance of project.

.2 Include types, serial number and dates of calibration of instruments.

.3 Record test data on a sepia made from the latest available revised set of mechanical drawings and submit four (4) copies upon completion of the balancing contract for inclusion in equipment and maintenance manuals.

.4 Install at each piece of mechanical equipment a "Data Register" showing significant operating temperatures, pressures, amperes, voltage, brake horsepower. "Data Register" to be enclosed in a plastic holder securely attached to the equipment or to a wall in the adjacent area.

.5 Submit with report, fan and pump curves with operating conditions plotted. Submit grille and diffuser Shop Drawings and diffusion factors.

.6 Report shall be indexed as follows:

.1 Air:

.1 Summary.

.2 Procedure.

.3 Instrumentation.

.4 Drawings.

.5 Equipment Summary.

.6 Fan Sheets.

.7 Fan Curves.

.8 Fan Profile Data.

.9 Static Data.

.10 Traverse Data and Schedule.

.11 Terminal Unit Summary.

.12 Outlet Data Summary and Schematics (per system).

.13 Building Pressurisation Data Diagnostic.

.2 Water and Hydronics:

.1 Summary.

.2 Procedure.

.3 Instrumentation.

.4 Drawings.

.5 Pump Data.

.6 Pump Curves.

.7 Coils.

.8 Equipment Data.

.9 Element Data Summary and Schematics (per system).

.10 Diagnostic.

3.6 Bring the Work to an Operating State and Ready for Balancing, Including:

.1 Clean equipment and ductwork.

.2 Install air terminal devices.

.3 Provide temporary filters in air handling equipment and carry out a rough air balance to ensure all equipment performs required function.

.4 Replace filters with specified filters prior to balancing.

.5 Verify lubrication of equipment.

.6 Install permanent instrumentation.

.7 Clean piping systems and strainers, clean systems as per Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems, drain and fill with clean heat exchange fluid.

.8 Complete the "start-up" of equipment.

.9 Adjust stuffing boxes and packing glands on pumps and valves.

.10 Check rotation and alignment of rotating equipment and tension of belted drives.

.11 Verify ratings of overload heaters in motor starters.

.12 Set control points of automatic apparatus, check-out sequence of operation.

.13 Make available control diagrams and sequence of operation.

.14 Clean work, remove temporary tags, stickers, and coverings.

.15 Make available one (1) copy of Maintenance Manuals especially for use in balancing.

.16 Provide Balancing Agency a complete set of mechanical drawings and specifications.

3.7 Cooperate with the Balancing Agency as follows:

.1 Make corrections as required by Balancing Agency.

.2 Allow Balancing Agency free access to site during construction phase. Inform Balancing Agency of any major changes made to systems during construction and provide a complete set of record drawings for their use.

.3 Operate automatic control system and verify set points during balancing.

3.8 Balancing Valves and Dampers

.1 Provide and install balancing valves, dampers, and other materials requested by the Balancing Agency and/or necessary to properly adjust or correct the systems to design flows, without additional cost to the City.

3.9 Pulleys and Sheaves

.1 Provide and install pulleys and sheaves for rotating equipment, as required to properly balance the systems to design flows, without additional cost to the City.

.2 In the event a variable frequency drive is available, this may be used for system balancing with prior approval from the Contract Administrator.

3.10 Shaving of Pump Impellers

.1 Allow in the Construction Contract price shaving of impellers as required to balance the pumps to design flow at operating condition.

.2 In the event a variable frequency drive is available, this may be used for system balancing with prior approval from the Contract Administrator.

END OF SECTION

DUCT INSULATION

1. GENERAL

1.1 Description

.1 For additional information, refer to Section 21 05 01 - Common Work Results for Mechanical and Division 1 - General Conditions of the Construction Contract.

.2 For a list of applicable codes and standards, refer to Section 21 05 01 - Common Work Results for Mechanical.

.3 The Construction Contractor shall be responsible for coordinating all aspects of this Work.

.4 Locations of equipment, ductwork, pipework, and all associated appurtenances indicated on the Drawings are approximate only. The Construction Contractor is responsible for checking and coordinating the locations of equipment, ductwork, pipework, and all associated appurtenances and shall make any necessary adjustments in positions to conform with the architectural features, other services, symmetry, clearances, and lighting arrangements.

1.2 Scope of Work

.1 The Scope of Work for this Section includes, but is not limited to, the following:

.1 Materials and procedures for the provision and installation of thermal insulation for HVAC ductwork systems.

1.3 Related Work

.1 This Section may not contain all materials, equipment and requirements required for the completion of this project. This Section is to be read in conjunction with the remaining Sections of Division 21, 22 and 23 and all related works.

.2 Division 1 forms an integral part of Division 21, 22 and 23.

1.4 References

.1 Except as specified herein, the latest edition of the standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

.2 In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

.3 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):

.1 ANSI/ASHRAE/IESNA 90.1, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.

.4 ASTM International Inc.:

.1 ASTM B209M, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

.2 ASTM C335, Standard Test Method for Steady-State Heat Transfer Properties of Pipe Insulation.

.3 ASTM C411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM C449/C449M, Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C547, Standard Specification for Mineral Fiber Pipe Insulation.

.6 ASTM C553, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

.7 ASTM C612, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

.8 ASTM C 795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.9 ASTM C921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.5 Canadian General Standards Board (CGSB):

.1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.6 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).

.7 Underwriters Laboratories of Canada (ULC).

.1 CAN/ULC-S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

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

1.5 Action and Informational Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical and Section 01 33 00 - Submittal Procedures for submission requirements.

.2 Product Data: Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Submit copies of WHMIS SDS - Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

1.6 Closeout Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical, Section 01 33 00 - Submittal Procedures, and Section 01 78 00 - Closeout Submittals for submission requirements.

1.7 Delivery, Storage and Handling

.1 Shipping:

.1 All equipment, material and spare parts shall be shipped, stored, handled, and installed in such a manner as not to degrade quality, serviceability, or appearance. Equipment and material warranties shall not be voided by actions of the Construction Contractor.

.2 Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

.3 Pack spare parts in containers bearing labels clearly designated contents and pieces of equipment for which intended.

.4 Deliver spare parts at same time as pertaining equipment. Deliver to the City after completion of Work.

.2 Receiving:

.1 All equipment, material and spare parts shall be delivered to the Site in original packages or containers bearing the manufacturer's labels and product identification.

.2 Inspect for damage and correctness, and inventory items, upon delivery to Site.

.3 Store equipment, material and spare parts protected for the weather, humidity and temperature variations, dirt and dust or other contaminants. Store and safeguard in accordance with Manufacturer's recommendations.

1.8 Quality Assurance

.1 Performance Requirements:

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

2. PRODUCTS

2.1 Definitions

.1 For purposes of this Section:

.1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED" - means "not concealed" as previously defined.

.3 Insulation systems - insulation material, fasteners, jackets, and other accessories.

.2 TIAC Codes:

.1 CRD: Code Round Ductwork.

.2 CRF: Code Rectangular Finish.

2.2 Fire and Smoke Rating

.1 To CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.3 Insulation

.1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C 335.

.3 TIAC Code C-1: Rigid mineral fibre board to ASTM C 612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).

.4 TIAC Code C-2: Mineral fibre blanket to ASTM C 553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).

.1 Mineral fibre: to ASTM C 553.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to ASTM C 553.

2.4 Jacketing

.1 Aluminum:

.1 To ASTM B 209 with moisture barrier as scheduled in PART 3 of this Section.

.2 Thickness: 0.50 mm sheet.

.3 Finish: Stucco embossed.

.4 Jacket banding and mechanical seals: 19 mm wide, 0.5 mm thick Type 316 stainless steel.

2.5 Accessories

.1 Vapour retarder lap adhesive:

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

.2 Tie wire: 1.5 mm stainless steel.

.3 Banding: 19 mm wide, 0.5 mm thick Type 316 stainless steel.

.4 Fasteners: 4 mm diameter pins with 35 mm square self-adhesive pads, length to suit thickness of insulation.

3. EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Pre-Installation Requirements

.1 Pressure test ductwork systems in accordance with SMACNA requirements complete, witness and certify.

.2 Ensure surfaces are clean, dry, and free from foreign material.

3.3 Installation

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturer’s instructions and as indicated.

.3 Use two (2) layers with staggered joints when required nominal thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.5 Ensure hangers, and supports are outside vapour retarder jacket.

.6 Hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.7 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

.8 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum two (2) rows each side.

3.4 Ductwork Insulation Schedule

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

Duct/Service	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular supply air ducts	C-1	Yes	50
Round supply air ducts	C-2	Yes	50
Supply, return and exhaust ducts exposed in space being served	C-1	No	25
Outside air ducts to mixing plenums or equipment	C-1	Yes	50
Mixing plenums	C-1	Yes	25
Exhaust duct between dampers and louvers, and from exterior wall insulation to minimum 1.5 m past dampers	C-1	No	25

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

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

.3 Finishes to conform to the following table:

Duct/Service	TIAC Code	
	Rectangular	Round
Indoor concealed	None	None
Indoor, exposed within mechanical room	CRF/3	CRD/4
Indoor exposed elsewhere	CRF/2	CRD/3

3.5 Cleaning

.1 Remove surplus materials, excess materials, rubbish, tools, and equipment.

END OF SECTION

1. GENERAL

1.1 Description

.1 For additional information, refer to Section 21 05 01 - Common Work Results for Mechanical and Division 1 - General Conditions of the Construction Contract.

.2 For a list of applicable codes and standards, refer to Section 21 05 01 - Common Work Results for Mechanical.

.3 The Construction Contractor shall be responsible for coordinating all aspects of this Work.

.4 Locations of equipment, ductwork, pipework, and all associated appurtenances indicated on the Drawings are approximate only. The Construction Contractor is responsible for checking and coordinating the locations of equipment, ductwork, pipework, and all associated appurtenances and shall make any necessary adjustments in positions to conform with the architectural features, other services, symmetry, clearances, and lighting arrangements.

1.2 Scope of Work

.1 The Scope of Work for this Section includes, but is not limited to, the following:

.1 Materials and procedures for the provision and installation of thermal insulation for plumbing and HVAC piping systems.

1.3 Related Work

.1 This Section may not contain all materials, equipment and requirements required for the completion of this project. This Section is to be read in conjunction with the remaining Sections of Division 21, 22 and 23 and all related works.

.2 Division 1 forms an integral part of Division 21, 22 and 23.

1.4 References

.1 Except as specified herein, the latest edition of the standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

.2 In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

.3 American Society for Testing and Materials International (ASTM):

.1 ASTM B209M, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

.2 ASTM C335, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.

.3 ASTM C411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM C449/C449M, Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C533, Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.

.6 ASTM C547, Standard Specification for Mineral Fiber Pipe Insulation.

.7 ASTM C795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.8 ASTM C921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.4 Canadian General Standards Board (CGSB):

.1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.2 CAN/CGSB-51.53, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.

.5 Manufacturer's Trade Associations:

.1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

.6 Underwriters' Laboratories of Canada (ULC):

.1 CAN/ULC-S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

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

.3 CAN/ULC-S702, Standard for Mineral Fibre Thermal Insulation for Buildings, Part 1: Material Specification.

.4 CAN/ULC-S702.2, Standard for Mineral Fibre Thermal Insulation for Buildings, Part 2: Installation.

1.5 Action and Informational Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical and Section 01 33 00 - Submittal Procedures for submission requirements.

.2 Product Data: Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Submit copies of WHMIS SDS - Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

1.6 Closeout Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical, Section 01 33 00 - Submittal Procedures, and Section 01 78 00 - Closeout Submittals for submission requirements.

1.7 Delivery, Storage and Handling

.1 Shipping:

.1 All equipment, material and spare parts shall be shipped, stored, handled, and installed in such a manner as not to degrade quality, serviceability, or appearance. Equipment and material warranties shall not be voided by actions of the Construction Contractor.

.2 Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

.3 Pack spare parts in containers bearing labels clearly designated contents and pieces of equipment for which intended.

.4 Deliver spare parts at same time as pertaining equipment. Deliver to the City after completion of Work.

.2 Receiving:

.1 All equipment, material and spare parts shall be delivered to the Site in original packages or containers bearing the manufacturer's labels and product identification.

.2 Inspect for damage and correctness, and inventory items, upon delivery to Site.

.3 Store equipment, material and spare parts protected for the weather, humidity and temperature variations, dirt and dust or other contaminants. Store and safeguard in accordance with Manufacturer's recommendations.

1.8 Quality Assurance

.1 Performance Requirements:

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

2. PRODUCTS

2.1 Definitions

.1 For purposes of this Section:

.1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.

.2 EXPOSED" - will mean "not concealed" as specified.

.2 TIAC Stainless Steel:

.1 CRF: Code Rectangular Finish.

.2 CPF: Code Piping Finish.

2.2 Fire and Smoke Rating

.1 In accordance with CAN/ULC-S102.

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.3 General

.1 Mineral fibre specified includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C mean temperature when tested in accordance with ASTM C 335.

2.4 Insulation

.1 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.

.1 Mineral fibre: to CAN/ULC-S702.

.2 Maximum "k" factor: to CAN/ULC-S702.

.2 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.

.1 Mineral fibre: to CAN/ULC-S702.

.2 Jacket: moisture permeability of less than 57.2 $ng \cdot s^{-1} \cdot m^{-2} \cdot Pa^{-1}$.

.3 Maximum "k" factor: to CAN/ULC-S702.

.3 TIAC Code A-6: flexible unicellular tubular elastomer.

.1 Insulation: with vapour retarder jacket.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: 0.036 W/m^2K.

.4 Certified by manufacturer: free of potential stress corrosion cracking corrodents.

2.5 Insulation Securement

.1 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.

.2 Contact adhesive: quick setting.

.3 Tie wire: 1.5 mm diameter stainless steel.

.4 Bands: 316 stainless steel, 19 mm wide, 0.5 mm thick.

2.6 Vapour Barrier Lap Adhesive

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

2.7 Jacketing

.1 Polyvinyl Chloride (PVC):

.1 One-piece moulded type to CAN/CGSB-51.53 with pre-formed shapes as required.

.2 Colours: White.

.3 Minimum service temperatures: minus 17°C.

.4 Maximum service temperature: 65°C.

.5 Moisture vapour transmission: 0.02 perm.

.6 Thickness: 0.5 mm.

.7 Fastenings:

.1 Use solvent weld adhesive compatible with insulation to seal laps and joints.

.2 Tacks.

.3 Pressure sensitive vinyl tape of matching colour.

.2 Aluminum:

.1 To ASTM B 209.

.2 Thickness: 0.50 mm sheet.

.3 Finish: stucco embossed.

.4 Joining: longitudinal and circumferential slip joints with 50 mm laps.

.5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.

.6 Metal jacket banding and mechanical seals: 316 stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

3. EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Pre-Installation Requirements

.1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.

.2 Surfaces clean, dry, free from foreign material.

3.3 Installation

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturer’s instructions and this specification.

.3 Use two (2) layers with staggered joints when required nominal wall thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.5 Install hangers, supports outside vapour retarder jacket.

.6 Hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment. Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.4 Removable Pre-Fabricated Insulation and Enclosures

.1 Application: at valves, flanges and unions at equipment.

.2 Design: to permit periodic removal and replacement without damage to adjacent insulation.

.3 Insulation:

.1 Insulation, fastenings and finishes: same as system.

.2 Jacket: aluminum high temperature fabric.

3.5 Installation of Elastomeric Insulation

.1 Insulation to remain dry. Overlaps to manufacturer’s instructions. Ensure tight joints.

.2 Provide vapour retarder as recommended by manufacturer.

3.6 Piping Insulation Schedules

.1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.

.2 TIAC Code: A-1.

.1 Securements: Tape at 300 mm on centre.

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code 1501-H.

.3 TIAC Code: A-3.

.1 Securements: Tape at 300 mm on centre.

.2 Seals: VR lap seal adhesive, VR lagging adhesive.

.3 Installation: TIAC Code: 1501-C.

.4 TIAC Code: A-6.

.1 Insulation securements: Pressure sensitive vinyl tape.

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code: 1501-CA.

.5 Thickness of insulation as listed in following table.

.1 Run-outs to individual units and equipment not exceeding 4000 mm long.

.2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Application	Temp (°C)	TIAC Code	Pipe Sizes (mm) and Insulation Thickness					
			Run Out	to 25	30 to 50	65 to 100	125 to 150	200 and over
Hot water heating	60-94	A-1	25	38	38	38	38	38
Hot water heating	Up to 59	A-1	25	25	25	25	38	38
Glycol heating	60-94	A-1	25	38	38	38	38	38
Glycol heating	Up to 59	A-1	25	25	25	25	38	38
Domestic Cold Water	4 - 20	A-3	25	25	25	25	25	25
Domestic Hot Water	60	A-1	25	25	25	25	38	38
Refrigerant Hot Gas	4-13	A-6	25	25	25	25	25	25
Refrigerant Liquid	Below 4	A-6	25	25	38	38	38	38

.6 Finishes:

.1 Exposed indoors: PVC jacket.

.2 Concealed, indoors: Canvas.

.3 Refrigeration piping, outdoors: UV resistant PVC or aluminum.

.4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.

.5 Finish attachments: stainless steel bands, at 150 mm on centre. Seals: closed.

.6 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.7 Cleaning

.1 Remove surplus materials, excess materials, rubbish, tools, and equipment.

END OF SECTION

PERFORMANCE VERIFICATION MECHANICAL PIPING SYSTEMS

1. GENERAL

1.1 Related Requirements

.1 Section 21 05 01 - Common Work Results for Mechanical.

1.2 References

.1 American Society for Testing and Materials International (ASTM):

.1 ASTM E202, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

1.3 Cleaning and Start-Up of Mechanical Piping Systems

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

1.4 Hydronic Systems - Performance Verification (PV)

.1 Perform hydronic systems performance verification after cleaning is completed and system is in full operation.

.2 When systems are operational, perform following tests:

.1 Conduct full scale tests at maximum design flow rates, temperatures and pressures for continuous consecutive period of forty-eight (48) hours to demonstrate compliance with design criteria.

.2 Verify performance of hydronic system circulating pumps as specified, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.

1.5 Hydronic System Capacity Test

.1 Perform hydronic system capacity tests after:

.1 TAB has been completed.

.2 Verification of operating, limit, safety controls.

.3 Verification of primary and secondary pump flow rates.

.4 Verification of accuracy of temperature and pressure sensors and gauges.

.2 Calculate system capacity at test conditions.

.3 Using manufacturer's published data and calculated capacity at test conditions, extrapolate system capacity at design conditions.

.4 When capacity test is completed, return controls and equipment status to normal operating conditions.

.5 Submit sample of system water to approved testing agency to determine if chemical treatment is correct. Include cost.

.6 Heating system capacity test:

.1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:

.1 Increasing OA flow rates through heating coils (in this case, monitor heating coil discharge temperatures to ensure that coils are not subjected to freezing conditions); or

.2 Reducing space temperature by turning of heating system for sufficient period of time before starting testing.

.2 Test procedures:

.1 Open fully heat exchanger, heating coil and radiation control valves.

.2 With boilers on full firing and hot water heating supply temperature stabilized, record flow rates and supply and return temperatures simultaneously.

1.6 Glycol Systems

.1 Test to prove concentration will prevent freezing to minus 40°C Test inhibitor strength and include in procedural report. Refer to ASTM E 202.

1.7 Potable Water Systems

.1 When cleaning is completed and system filled:

.1 Verify performance of equipment and systems as specified elsewhere in Division 23.

.2 Check for proper operation of water hammer arrestors. Run one outlet for ten (10) seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or recharge air chambers. Repeat for each outlet and flush valve.

.3 Confirm water quality consistent with supply standards, verifying that no residuals remain resulting from flushing and/or cleaning.

1.8 Sanitary Drainage Systems

.1 Buried systems: perform tests prior to back-filling. Perform hydraulic tests to verify grades and freedom from obstructions.

.2 Ensure that traps are fully and permanently primed.

.3 Ensure that fixtures are properly anchored, connected to system.

.4 Operate flush valves, tank and operate each fixture to verify drainage and no leakage.

.5 Cleanouts: refer to Section 22 42 01 - Plumbing Specialties and Accessories.

1.9 Reports

.1 In accordance with Section 01 91 31 - Commissioning Plan.

1.10 Training

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

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS

1. GENERAL

1.1 Scope

.1 Provide for cleaning and degreasing of hot water heating and glycol systems.

.2 Provide all necessary equipment and chemicals to treat hot water heating and glycol systems.

.3 Provide for flushing and disinfection of domestic water systems.

1.2 Acceptable Agency

.1 Chemical treatment agency shall provide equipment, chemicals and site supervision so as to fully comply with all requirements and their intent contained within this specification section.

.2 Acceptable Agency: Solenis, Pace Chemicals Ltd., IPAC Chemicals Ltd.

1.3 Quality Assurance

.1 Perform the cleaning and degreasing operation on site in conjunction with the mechanical contractor and submit written reports on all situations found, actions taken and final results. Reports shall be signed by the Contractor and chemical treatment agency. Inform the Contract Administrator fifteen (15) working days prior to commencing of Work.

.2 Chemical treatment agency shall provide directive and assistance to the mechanical contractor in the degreasing, cleaning and chemical treatment of all piping systems. Use of the permanent mechanical systems for pumping or heating of cleaning and dilution solutions is not permitted. Permanent systems shall be isolated and portable pumps and boilers utilised for the duration of the cleaning process. Permanent equipment shall be flushed, degreased and chemically treated independent of the piping systems.

1.4 Submittals

.1 Submit Shop Drawings with complete description of proposed chemicals, quantities, calculations, procedures, test kits and equipment to be supplied. Along with product Shop Drawings, provide copies of data sheets, procedure instructions and analysis reports to be used on this project. Shop Drawings shall be submitted within ten (10) working days of the award of Contract.

.2 Include with the Shop Drawings Safety Data Sheets (SDS) for all chemicals to be used.

.3 Provide written reports to the mechanical contractor and Contract Administrator containing procedure of system cleaning and degreasing, giving times, dates, conditions of water and problems and actions encountered.

.4 Submit written reports to the mechanical contractor and Contract Administrator containing results of tests taken every seven days after completion of chemical treatment. Reports shall be done every seven (7) days for a minimum time period of thirty-five (35) days.

.5 Provide monthly site visits (twelve (12) minimum) within the warranty year to check the treatment, take samples, analyse and recommend proper addition of treatment. Provide written reports to the City after each visit with a copy to the Contract Administrator.

2. PRODUCTS

2.1 Materials

.1 Provide sufficient chemicals to treat and test the systems from the time of activation and acceptance of the building for the first year of operation by the City.

.2 Materials which may contact finished areas shall be colourless and non-staining. Chemicals used must comply with environmental and health standards applicable to the usage on this project.

.3 System Cleaner: Alkaline compound which in solution removes grease and petroleum products.

.4 Close System Treatment: Sequestering agent to reduce deposits and adjust pH, and a corrosion inhibitor.

2.2 Equipment

.1 Solution Pumps: Provide positive displacement diaphragm type metering pumps for adding chemicals. Pumps shall have an adjustable flow rate and be suitable for chemicals to be pumped. Pumps shall be self-flushing. Provide pumps with plastic solution tanks complete with agitator, pump mounting, cover, provision for fill line and pump strainer. Size the pumps and tanks to permit operation for three days at 50% pump capacity without refill of tanks. Provide agitator motor with terminals and junction box for electric wiring.

.2 Provide chemical pot feeder as specified in Section 23 21 14 – Hydronic Specialties, located as shown on system schematics and floor plans. If location is in question obtain clarification from the Contract Administrator prior to installation.

2.3 Test Kits

.1 Provide test kits as required to determine proper system treatment consisting of, but not limited to the following:

.1 Heating water test kit to determine proper treatment.

.2 Glycol systems treatment test kits to determine proper concentration and glycol inhibitor, this shall include a hydrometer type tester.

.3 Air washer (domestic cold water) treatment test kits to determine proper treatment and blowdown.

.2 Provide test kits for hardness and chlorides in addition to those listed above.

.3 Provide an electronic pH meter complete with three different calibration standard solutions.

.4 All test kits shall be provided with adequate chemicals and reagents for one (1) year of testing.

3. EXECUTION

3.1 System Cleaning

.1 Ensure reasonable care is exercised to prevent debris, dirt and other foreign material from entering the pipe during construction. This is to include proper protection of piping on Site prior to installation, temporary caps on partial systems, and complete evacuation of moisture within systems being hydrostatically pressure tested.

.2 Chemical treatment agency shall, in conjunction with the mechanical contractor, review connections for complete draining and venting of the systems. The mechanical contractor shall provide adequate drain connections to completely drain the systems within one (1) hour. Utilise water meter to record capacity within each system, and record for maintenance manuals.

.3 Protect and/or remove control devices from systems during cleaning. All terminal control valves shall be in open position during cleaning. Particular attention is to be made to control valves which have a normally closed position.

.4 Make systems completely operational, totally filled, thoroughly vented, and completely started.

.5 Add system cleaner and degreasant to flow systems at concentration of 1 kg per 1000 L (8.3 lb per 1000 USgal) of water contained in systems for hot systems, 1 kg per 500 L (8.3 lb per 500 USgal) of water for cold systems and fill the boilers only with cleaner for steam systems.

.6 For hot water heating systems apply heat while circulating, raise temperature to 71°C (160°F) slowly and maintain at 71°C (160°F) for a minimum of twelve (12) hours. Remove heat and circulate systems to 38°C (100°F) or less. Drain system, entirely at one time, including all low points and coils. Intermittent start/stop of drainage is not approved. The mechanical contractor to provide additional temporary pipe, pumps as necessary and drainage location for complete drainage. Refill the entire system with clean water, circulate for six hours at design temperature, provide complete venting and deaeration, repeat the draining procedure. Refill complete system with clean water and retest.

.7 For glycol systems utilise the same procedure for hot water heating systems specified above.

.8 Inspect, clean of sludge and flush all low points with clean water after cleaning and degreasing process is completed. Include disassembly of components as required. All cleaning and flushing of low points, coils, boilers, etc. shall be done prior to final fill and chemical treatment.

.9 All domestic hot, cold and domestic recirculation water systems will be required to be flushed and disinfected. Add chlorine to water in system to 50 mg per L (190 mg per USgal) and let stand for twenty-four (24) hours. Check chlorine content after twenty-four (24) hours and insure the content is not less than 20 mg per L (75 mg per USgal). If less than 20 mg per L (75 mg per USgal) repeat process. Flush system until the chlorine content of water being

drained is equal to the chlorine content of the make-up water. Utilise plumbing fixtures (i.e. lavatories, sinks, flushometers, etc.) for drainage.

3.2 Heating Water and Glycol Systems

.1 Provide one (1) pot feeder for each individual system. Install complete with isolating and drain valves and necessary piping. Install as indicated on schematics.

.2 Treat closed systems with closed systems treatment introduced through pot feeder when required or indicated by test.

.3 Provide one side stream 5 micron filter per main circulation pump system, complete with isolation valves, unions, and bypass with N.C. valve.

.4 Provide "Dowfrost" brand propylene glycol to 50% for heating system to act as an antifreeze solution.

END OF SECTION

CONTROL VALVES

1. GENERAL

1.1 Description

.1 Provide control valves and actuators for HVAC systems as indicated and in compliance with Contract Documents.

1.2 References

.1 ANSI FCI:

.1 70-2: Control Valve Seat Leakage.

.2 American Society of Mechanical Engineers (ASME):

.1 Boiler and Pressure Vessel Code.

.2 B16.5: Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard.

.3 B61.1: Standard Specification for Steam or Valve Bronze Castings.

.3 ASTM International (ASTM):

.1 A126: Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

.2 A216: Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.

.3 A536: Standard Specification for Ductile Iron Castings.

.4 B61: Standards Specification for Steam or Valve Bronze Castings.

.5 B62: Standard Specification for Composition Bronze or Ounce Metal Castings.

.6 B584: Standard Specification for Copper Alloy Sand Castings for General Applications.

.4 International Society of Automation (ISA):

.1 75.01.01: Industrial-Process Control Valves – Part 2-1: Flow Capacity – Sizing Equations for Fluid Flow Under Installed Conditions.

.2 75.08.01: Face-to-Face Dimensions for Integral Flanged Globe-Style Control Valve Bodies (Classes 126, 150, 250, 300 and 600).

.3 75.11.01: Inherent Flow Characteristics and Rangeability of Control Valves.

.5 Manufacturers' Standardization Society (MSS):

.1 SP-67: Butterfly Valves.

.2 SP-68: High Pressure Butterfly Valves with Offset Design.

.3 Sp-110: Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.3 Definitions

.1 Cv: Design valve coefficient.

.2 PCS: Plant Control System.

.3 NBR: Nitrile butadiene rubber.

.4 PTFE: Polytetrafluoroethylene.

1.4 Submittals

.1 Submit the following shop drawings in accordance with Section 01 33 00.

.2 Product Data: For each type of product, including the following:

.1 Construction details, material descriptions, dimensions of individual components and profiles, and finishes.

.2 Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.

.3 Product description with complete technical data, performance curves, and product specification sheets.

.4 Installation, operation, and maintenance instructions, including factors affecting performance.

.3 Shop Drawings:

.1 Include plans, elevations, sections, and mounting details.

.2 Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

.3 Include diagrams for power, signal, and control wiring.

.4 Delegated-Design Submittal:

.1 Schedule and design calculations for control valves and actuators, including the following:

.1 Flow at project design and minimum flow conditions.

.2 Pressure differential drop across valve at project design flow condition.

.3 Maximum system pressure differential drop (pump close-off pressure) across valve at project minimum flow condition.

.4 Design and minimum control valve coefficient with corresponding valve position.

.5 Maximum close-off pressure.

.6 Leakage flow at maximum system pressure differential.

.7 Torque required at worst case condition for sizing actuator.

.8 Actuator selection indicating torque provided.

.5 Operation and Maintenance Data: For control valves to include in operation and maintenance manuals.

1.5 Spare Parts

.1 Comply with the requirements specified in Section 01 61 00.

1.6 Quality Assurance

.1 Comply with the requirements specified in Section 01 45 00.

1.7 Delivery Storage and Handling

.1 Comply with the requirements specified in Section 01 61 00.

2. PRODUCTS

2.1 Performance Requirements

.1 Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

.2 ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by Authorities Having Jurisdiction.

.3 Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.

.4 Backup Power Source: Systems and equipment served by a backup power source shall have associated control valve actuators served from a backup power source.

.5 Environmental Conditions:

.1 Provide electric control valve actuators, with protective enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Electric control valve actuators not available with integral enclosures, complying with requirements indicated, shall be housed in protective secondary enclosures.

.1 Hazardous Locations: Explosion-proof rating for condition.

.6 Selection Criteria:

.1 Control valve shutoff classifications shall be FCI 70-2, Class IV or better unless otherwise indicated.

.2 Valve pattern, three-way or straight through, shall be as indicated on drawings or control schematics.

.3 Modulating straight-through pattern control valves shall have equal percentage flow-throttling characteristics unless otherwise indicated.

.4 Modulating three-way pattern water valves shall have linear flow-throttling characteristics. The total flow through the valve shall remain constant regardless of the valve's position.

.5 Globe-type control valves shall pass the design flow required with not more than 95% of stem lift unless otherwise indicated.

.6 Selection shall consider viscosity, flashing, and cavitation corrections.

.7 Valves shall have stable operation throughout full range of operation, from design to minimum Cv.

.8 In water systems, select modulating control valves at terminal equipment for a design Cv based on a pressure drop of 5 psig at design flow unless otherwise indicated.

.9 Two-position control valves shall be line size unless otherwise indicated.

.10 In water systems, use ball- or globe-style control valves for two-position control for valves NPS 2 and smaller and butterfly style for valves larger than NPS 2.

.11 Globe-style motorized control valves are to be used for all modulating flow applications.

2.2 Ball-Style Control Valves

.1 Ball Valves with Single Port and Characterized Disk:

.1 Manufacturers:

.1 Jenkins Valves.

.2 Toyo.

.3 Crane.

.4 Kitz Corporation.

.5 Milwaukee Valve Company.

.6 WATTS.

.7 MAS.

.8 Belimo.

.2 Pressure Rating for NPS 1 and Smaller: Nominal 600 WOG.

.3 Pressure Rating for NPS 1-1/2 through NPS 2: Nominal 400 WOG.

.4 Close-off Pressure: 200 psig.

.5 Process Temperature Range: Zero to 212°F.

.6 Body and Tail Piece: Cast bronze ASTM B61, ASTM B62, ASTM B584, or forged brass with nickel plating.

.7 End Connections: Threaded (NPT) ends.

.8 Ball: Chrome-plated brass or bronze.

.9 Stem and Stem Extension:

.10 Material to match ball.

.11 Blowout-proof design.

.12 Sleeve or other approved means to allow valve to be opened and closed without damaging the insulation or the vapor barrier seal.

.13 Ball Seats: Reinforced PTFE.

.14 Stem Seal: Reinforced PTFE packing ring with a threaded packing ring follower to retain the packing ring under design pressure with the linkage removed. Alternative means, such as EPDM O-rings, are acceptable if an equivalent cycle endurance can be demonstrated by testing.

.15 Flow Characteristic: Equal percentage.

2.3 Butterfly-Style Control Valves

.1 Commercial-Grade, Two-Way Butterfly Valves:

.1 Manufacturers:

.1 Keystone.

.2 Kitz Corporation.

.3 Apollo Flow Controls.

.4 NIBCO, Inc.

.5 Toyo.

.6 Tyco Grinnell.

.7 MAS.

.2 Performance:

.1 Bi-directional bubble tight shutoff at 1724 kPa.

.2 Comply with MSS SP-67 or MSS SP-68.

.3 Rotation: Zero to 90 degrees.

.4 Linear or modified equal percentage flow characteristic.

.3 Body: Cast iron ASTM A126, Class B, ductile iron ASTM A536 or cast steel ASTM A216 WCB fully lugged, suitable for mating to ASME B16.5 flanges.

.4 Disc: 316 stainless steel.

.5 Shaft: 316 or 17-4 PH stainless steel.

.6 Seat: Reinforced EPDM or reinforced PTFE with retaining ring.

.7 Shaft Bushings: Reinforced PTFE or stainless steel.

.8 Replaceable seat, disc, and shaft bushings.

.9 Corrosion-resistant nameplate indicating:

.1 Manufacturer's name, model number, and serial number.

.2 Body size.

.3 Body and trim materials.

.4 Flow arrow.

2.4 Globe-Style Control Valves

.1 General Globe-Style Valve Requirements:

.1 Globe-style control valve body dimensions shall comply with ISA 75.08.01.

.2 Construct the valves to be serviceable from the top.

.3 For cage guided valves, trim shall be field interchangeable for different valve flow characteristics, such as equal percentage, linear, and quick opening.

.4 Reduced trim for one nominal size smaller shall be available for industrial valves NPS 1 and larger.

.5 Replaceable seats and plugs.

.6 Furnish each control valve with a corrosion-resistant nameplate indicating the following:

.1 Manufacturer's name, model number, and serial number.

.2 Body and trim size.

.3 Arrow indicating direction of flow.

.2 Two-Way Globe Valves NPS 2 and Smaller:

.1 Manufacturers:

.1 Johnson Controls.

.2 Fisher.

.3 Siemens.

.4 Belimo.

.3 Globe Style: Single port.

.1 Body: Cast bronze or forged brass with ASME B16.5, Class 250 rating.

.2 End Connections: Threaded.

.3 Bonnet: Screwed.

.4 Packing: PTFE V-ring.

.5 Plug: Top guided.

.6 Plug, Seat, and Stem: Stainless steel.

.7 Process Temperature Range: 2 to 120°C.

.8 Ambient Operating Temperature: 2 to 65°C.

.9 Leakage: FCI 70-2, Class IV.

.10 Rangeability: 25 to 1.

.11 Equal percentage flow characteristic.

.4 Three-Way Globe Valves NPS 2 and Smaller:

.1 Manufacturers:

.1 Johnson Controls.

.2 Fisher.

.3 Siemens.

.4 Belimo.

.5 Globe Style: Mix flow pattern.

.1 Body: Cast bronze or forged brass with ASME B16.5, Class 250 rating.

.2 End Connections: Threaded.

.3 Bonnet: Screwed.

.4 Packing: PTFE V-ring.

.5 Plug: Top guided.

.6 Plug, Seat, and Stem: Stainless steel.

.7 Process Temperature Range: 2 to 120°C.

.8 Ambient Operating Temperature: 2 to 65°C.

.9 Leakage: FCI 70-2, Class IV.

.10 Rangeability: 25 to 1.

.11 Linear flow characteristic.

.6 Two-Way Globe Valves NPS 2-1/2 to NPS 6:

.1 Manufacturers:

.1 Johnson Controls.

.2 Fisher.

.3 Siemens.

.4 Belimo.

.2 Globe Style: Single port.

.3 Body: Cast iron complying with ASME B61.1, Class 125.

.4 End Connections: Flanged, suitable for mating to ASME B16.5, Class 150 flanges.

.5 Bonnet: Bolted.

.6 Packing: PTFE cone-ring.

.7 Plug: Top or bottom guided.

.8 Plug, Seat, and Stem: Brass or stainless steel.

.9 Process Temperature Rating: 2 to 138°C.

.10 Leakage: 0.1% of maximum flow.

.11 Rangeability: Varies with valve size between 6 and 10 to 1.

.12 Modified linear flow characteristic.

.7 Three-Way Globe Valves NPS 2-1/2 to NPS 6:

.1 Manufacturers:

.1 Johnson Controls.

.2 Fisher.

.3 Siemens.

.4 Belimo.

.2 Globe Style: Mix flow pattern.

.3 Body: Cast iron complying with ASME B61.1, Class 125.

.4 End Connections: Flanged suitable for mating to ASME B16.5, Class 150 flanges.

.5 Bonnet: Bolted.

.6 Packing: PTFE cone-ring.

.7 Plug: Top or bottom guided.

.8 Plug, Seat, and Stem: Brass or stainless steel.

.9 Process Temperature Rating: 2 to 138°C.

.10 Leakage: 0.1% of maximum flow.

.11 Rangeability: Varies with valve size between 6 and 10 to 1.

.12 Modified linear flow characteristic.

2.5 Electronic Control Valve Actuators

.1 Manufacturers:

.1 Schischek by Rotork Controls.

.2 Belimo.

.3 Johnson Controls.

.4 Siemens.

.5 Or approved equal in accordance with B7.

.2 CSA or cUL approved.

.3 Operating voltage: 120 VAC.

.4 Actuators for Hydronic Control Valves: Capable of closing valve against system pump shutoff head.

.5 Position indicator and graduated scale on each actuator.

.6 Deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.

.7 Field Adjustment:

.1 Spring Return Actuators: Easily switchable from fail open to fail closed in the field without replacement.

.2 Gear Type Actuators: External manual adjustment mechanism to allow manual positioning when the actuator is not powered.

.8 Two-Position Actuators:

.1 Single direction, spring return or reversing type.

.2 Provide two auxiliary end-switch contacts, one for fully open and one for fully close.

.3 Position feedback: Equip two-position actuators with limits switches or other positive means of a position indication signal for remote monitoring of open and close position.

.9 Modulating Actuators:

.1 Operation: Capable of stopping at all points across full range and starting in either direction from any point in range.

.2 Control Input Signal:

.1 Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for 4-20 mA signals.

.2 Programmable Multi-Function:

.3 Control Input, Position Feedback, and Running Time: Factory or field programmable.

.4 Diagnostic: Feedback of hunting or oscillation, mechanical overload, mechanical travel, and mechanical load limit.

.5 Position feedback: Equip modulating actuators with position feedback through 4-20 mA signals for remote monitoring.

.10 Fail-Safe:

.1 Where indicated, provide actuator to fail to an end position.

.2 Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.

.3 Batteries, capacitors, and other non-mechanical forms of fail-safe operation are acceptable only where uniquely indicated.

.11 Integral Overload Protection:

.1 Provide against overload throughout the entire operating range in both directions.

.2 Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.

.12 Valve Attachment:

.1 Unless otherwise required for valve interface, provide an actuator designed to be directly coupled to valve shaft without the need for connecting linkages.

.2 Attach actuator to valve drive shaft in a way that ensures maximum transfer of power and torque without slippage.

.3 Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.

.13 Temperature and Humidity:

.1 Temperature: Suitable for operating temperature range encountered by application with minimum ambient operating temperature range of -40°C to +50°C.

.2 Humidity: Suitable for humidity range encountered by application; minimum operating range shall be from 5 to 95% relative humidity, non-condensing.

.14 Enclosure:

.1 Suitable for ambient conditions encountered by application.

.2 NEMA 250, Type 2 for indoor and protected applications.

.3 NEMA 250, Type 4 or Type 4X for outdoor and unprotected applications.

.4 NEMA 4X for Category 1 and Category 2 applications as indicated on electrical design plans.

.5 Provide actuator enclosure with heater and control where required by application.

.15 Stroke Time:

.1 Operate valve from fully closed to fully open within 60 seconds.

.2 Operate valve from fully open to fully closed within 60 seconds.

.3 Move valve to failed position within 25 seconds.

.4 Select operating speed to be compatible with equipment and system operation.

.16 Sound:

.1 Spring Return: 62 dBA.

.2 Non-Spring Return: 50 dBA.

3. EXECUTION

3.1 Examination

.1 Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

.2 Examine roughing-in for valves installed in piping to verify actual locations of piping connections before installation.

.3 Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

.4 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Control Valve Applications

.1 Control Valves:

.1 Select from valves specified in "Control Valves" Article to achieve performance requirements and characteristics indicated while subjected to full range of system operation encountered.

3.3 Installation, General

.1 Furnish and install products required to satisfy most stringent requirements indicated.

.2 Install products level, plumb, parallel, and perpendicular with building construction.

.3 Properly support instruments, tubing, piping, wiring, and conduits to comply with requirements indicated. Brace all products to prevent lateral movement and sway.

.4 Provide ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

.5 Firestop penetrations made in fire-rated assemblies and seal penetrations made in acoustically rated assemblies.

.6 Fastening Hardware:

.1 Stillson wrenches, pliers, and other tools that will cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for assembling and tightening nuts.

.2 Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.

.3 Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

.7 Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for City's access, confirm unrestricted ladder placement is possible under occupied condition.

.8 Corrosive Environments:

.1 Use products that are suitable for environment to which they will be subjected.

.2 If possible, avoid or limit use of materials in corrosive environments.

.3 Use Type 316 stainless-steel tubing and fittings when in contact with a corrosive environment.

.4 When conduit is in contact with a corrosive environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.

.5 Where control devices are located in a corrosive environment and are not corrosive resistant from manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.4 Electric Power

.1 Furnish and install electrical power to products requiring electrical connections.

.2 Furnish and install raceways. Comply with requirements in Division 26.

3.5 Control Valves

.1 Install pipe reducers for valves smaller than line size. Position reducers as close to valve as possible but at distance to avoid interference and impact to performance. Install with manufacturer-recommended clearance.

.2 Install flanges or unions to allow drop-in and -out valve installation.

.3 Where noted below, install control valve with three-valve bypass manifold to allow for control valve isolation and removal without interrupting system flow by providing manual throttling valve in bypass pipe.

.1 Bypass at all ERV, Air handler and Make-up Air Handler heating coils.

.4 Install drain valves in piping upstream and downstream of each control valve installed in a three-valve manifold and for each control valve larger than NPS 2.

.5 Install pressure temperature taps in piping upstream and downstream of each control valve larger than NPS 2.

3.6 Valve Orientation

.1 Where possible, install globe and ball valves installed in horizontal piping with stems upright and not more than 15 degrees off of vertical, not inverted.

.2 Install valves in a position to allow full stem movement.

.3 Where possible, install butterfly valves that are installed in horizontal piping with stems in horizontal position and with low point of disc opening with direction of flow.

3.7 Clearance

.1 Locate valves for easy access and provide separate support of valves that cannot be handled by service personnel without hoisting mechanism.

.2 Install valves with at least 300 mm of clear space around valve and between valves and adjacent surfaces.

3.8 Threaded Valves

.1 Note internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.

.2 Align threads at point of assembly.

.3 Apply thread compound to external pipe threads, except where dry seal threading is specified.

.4 Assemble joint, wrench tight. Apply wrench on valve end as pipe is being threaded.

3.9 Flanged Valves

.1 Align flange surfaces parallel.

.2 Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

3.10 Connections

.1 Connect electrical devices and components to electrical grounding system. Comply with requirements in Section 26 05 28.

3.11 Identification

.1 Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection.

.2 Install engraved phenolic nameplate with valve identification on valve.

3.12 Cleaning

.1 Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed interior and exterior surfaces.

.2 Wash and shine glazing.

.3 Polish glossy surfaces to a clean shine.

3.13 Checkout Procedures

.1 Control Valve Checkout:

.1 Check installed products before continuity tests, leak tests, and calibration.

.2 Check valves for proper location and accessibility.

.3 Check valves for proper installation for direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.

.4 Verify that control valves are installed correctly for flow direction.

.5 Verify that valve body attachment is properly secured and sealed.

.6 Verify that valve actuator and linkage attachment are secure.

.7 Verify that actuator wiring is complete, enclosed, and connected to correct power source.

.8 Verify that valve ball, disc, and plug travel are unobstructed.

.9 After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.

3.14 Adjustment, Calibration, and Testing

.1 Stroke and adjust control valves following manufacturer's recommended procedure, from 100% open to 100% closed back to 100% open.

.2 Check and document open and close cycle times for applications with a cycle time of less than thirty (30) seconds.

.3 For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

3.15 Closeout Activities

.1 Provide in accordance with Section 01 78 00.

END OF SECTION

1. GENERAL

1.1 Description

.1 Provide HVAC controls, field components and instruments as indicated and in compliance with Contract Documents.

.2 This Section is a supplement to instruments and controls in Division 40.

.3 The requirements of this Section shall be provided in addition to those listed in Division 40.

1.2 References

.1 Canadian Standards Association (CSA):

.1 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations, most current adopted edition.

.2 City of Winnipeg:

.1 Automation Design Guide.

.2 Electrical Design Guide.

.3 Winnipeg Electrical By-Law.

.4 Information Bulletins.

1.3 Submittals

.1 Submit the following Shop Drawings in accordance with Section 01 33 00.

1.4 Spare Parts

.1 Comply with the requirements specified in Section 01 61 00.

1.5 Quality Assurance

.1 Comply with the requirements specified in Section 01 45 00.

1.6 Delivery Storage and Handling

.1 Comply with the requirements specified in Section 01 61 00.

2. PRODUCTS

2.1 HVAC Control Panels (HCP)

.1 Provided in Division 40.

2.2 Control Dampers

.1 General:

.1 See Section 23 33 15.

.2 Furnish opposed-blade type for proportional action and parallel-blade type for two-position action, except where indicated otherwise in the Contract Documents.

.2 Instrumentation and Controls:

.1 The dampers shall have the option of being controlled locally or remotely via the main PCS system.

.2 Communication protocols as described in the Instrumentation and Controls Sections shall be used, to ensure compatibility of all systems.

.3 Shop Assembly:

.1 The dampers shall be fully assembled to the maximum extent possible.

2.3 Control Damper Operators

.1 General:

.1 See Section 23 33 15.

.2 Drawings and Control Diagrams indicate only one damper motor for each motorized damper (M).

.3 Select actual quantity of motors required to operate each damper in accordance with the size of damper provided.

.4 Coordinate exact quantity of damper motors with electrical Work to ensure that necessary wiring and conduit is provided for installation.

.5 Provide operators for motorized dampers and motorized louvers for all cases where an operator is not supplied as part of a unit.

2.4 Automatic Control Valves

.1 General:

.1 See Section 23 09 23.11.

2.5 Valve Actuators

.1 General:

.1 See Section 23 09 23.11.

.2 Coordinate exact quantity of actuators with electrical Work to ensure that necessary wiring and conduit is provided for installation.

2.6 Electric Thermostats

.1 Process Area Room Thermostat:

.1 Modulating electric type, except where two-position action is required.

.2 Temperature Scale: Furnish 1 to 35°C dial.

.3 External adjustments, temperature display.

.4 Adjustable sensitivity.

.5 Approvals: CSA or cUL.

.6 Type C contact rated for min 24 VDC.

.7 Insulating back where exterior wall mounting is indicated in the Contract Documents.

.8 Locking wire protective guard.

.9 Enclosure and sensing element to match area classification and moisture/corrosion category.

2.7 Electronic Sensors

.1 See Section 40 91 01.

.2 Temperature:

.1 General Requirements:

.1 Sensors and transmitters shall be provided, as outlined in the control schematics, input/output summary and sequence of operations.

.2 Temperature sensor shall be resistance type, and shall be two-wire 1,000-ohm platinum RTD.

.3 The following point types (and accuracy of each) are required, and their associated accuracy values include errors associated with sensor, lead wire, and A to D conversion:

Point Type	Accuracy
Hot / Chilled Water	+ 0.25°C
Room Temperature	+ 0.25°C
Duct Temperature	+ 0.25°C
All Others	+ 0.39°C

.3 Room Temperature:

.1 Constructed for either surface or wall box mounting.

.2 Non-locking wire protective guards for room temperature sensors installed in process areas.

.4 Room Temperature Sensors with Integral Display

.1 Constructed for either surface or wall box mounting.

.2 Non-locking wire protective guards for room temperature sensors installed in process areas.

.3 Integral LCD display and four button keypad with the following capabilities:

.1 Display room and outside air temperatures.

.2 Display and adjust room comfort set point.

.3 Display and adjust fan operation status.

.4 Timed override request pushbutton with LED status for activation of after-hours operation.

.5 Display controller mode.

.6 Password selectable adjustment of set point and override modes.

.5 Duct Temperature:

.1 Accuracy: +/-1°C.

.2 Range:

.1 Heating: 4 to 60°C.

.2 Cooling: -1 to 37°C.

.3 Element:

.1 Rigid insertion, 300 mm length, through sealed opening in center of duct.

.2 Averaging, for ducts or plenums with any dimension greater than 36 inches. Sealed opening in duct. Sensing element incorporated in copper capillary a minimum of 6 m long, serpentine across full area of airflow.

.6 Water Temperature:

.1 Accuracy: +/-1°C

.2 Range: -1 to 30°C for Chilled water supply/return; 10 to 121°C for heating glycol supply and return.

.3 Element: Removable insertion into pipe thermowell.

.4 Cover: NEMA 250 Type, suitable for area classification; in accordance with NFPA 70.

.7 Outdoor Temperature:

.1 Accuracy: +/-1°C.

.2 Range: -50 to 50°C.

.3 Cover: Weathertight, with sealed conduit connection and sun shield.

.8 Pressure (PS):

.1 Air Pressure:

.1 Accuracy: 5% of range.

.2 Range: 150% of measured variable.

.3 Mount non-vibrating.

.4 Cover: NEMA 250 Type, suitable for area classification; in accordance with NFPA 70.

.9 Water Pressure:

.1 Dwyer Instruments Inc.; No. 630 Series, 0 to 138 kPa.

.2 Transicoil Inc. (Robinson Halpern); No. 151 Series.

.10 Differential Pressure:

.1 General:

.1 Temperature compensated.

.2 Vary output voltage with change in differential pressure. Voltage shall vary linearly from 0 to 10 VDC according to differential pressure between high and low pressure ports.

.3 Sensing range shall be suitable for application with linearity of 1.5% of full scale and offset of less than 1% of full scale.

.4 Capable of withstanding up to 150% of rated pressure without damage.

.5 Compatible with 14 V to 30 VDC supply voltage range.

.2 Duct Air Static Differential Pressure (Flow Measurement):

.1 Ultra-low differential pressure and flow transmitter.

.2 0.5% of natural span accuracy.

.3 4-20 mA output.

.4 Pressure range to sit application.

.5 Integral 3-way zeroing valve.

.6 Built-in square root function.

.7 NEMA 12 enclosure.

.8 Veltron DPT 2500 transmitter with NEMA 12 enclosure.

.9 Sensocon A3 controller/display with NEMA 12 enclosure.

.11 Space Air Static Differential Pressure: MAMAC Systems Inc. or Setra transmitter

.12 Water Differential Pressure:

.1 Dwyer Instruments Inc.; No. 630 Series, 0 to 138 kPa range.

.2 Rosemount Controls Inc.; No. 1151-DP Series.

.3 Include three-valve manifold connection.

.13 Position Indicator:

.1 0 to 100% open, for damper, inlet vane, or similar.

.2 Potentiometer, 0 to 2,000 ohm equals 0 to 100%.

.14 Relative Humidity (RH):

.1 Room Relative Humidity.

.2 Accuracy: +/-2%.

.3 Range: 10 to 95%.

.4 Solid state.

2.8 High Temperature Detectors

.1 The high temperature switch shall be of the automatic reset type with Double Pole/Single Throw snap acting contacts rated for 16 amps at 120 VAC. An auxiliary contact shall be provided for remote alarm (EMS) monitoring of a high temperature condition.

.2 The sensing element shall be bi-metal type.

.3 Sensing element shall react to the warmest section of the multi section element.

.4 Thermostat element shall be a probe type.

.5 For large duct areas where the sensing element does not provide full coverage of the air stream, additional thermostats shall be provided as required to provide full protection of the air stream.

.6 Provide means of providing a time delay on the high temperature cut out where required and indicated on the Drawings.

2.9 Low Temperature Detectors

.1 The low temperature switch shall be of the automatic reset type with Double Pole/Single Throw snap acting contacts rated for 16 amps at 120 VAC. An auxiliary contact shall be provided for remote alarm (EMS) monitoring of a low temperature condition.

.2 The sensing element shall be a minimum of 3 m in length and shall react to the coldest 450 mm section.

.3 Element shall be of sufficient length to allow a serpentine distribution across the duct cross section and provide an accurate indication of the air flow temperature, especially in the case where a mixed air temperature is being measured.

.4 For large duct areas where the sensing element does not provide full coverage of the air stream, additional switches shall be provided as required to provide full protection of the air stream.

.5 Provide means of providing a time delay on the low temperature cut out where required and indicated on the Drawings.

3. EXECUTION

3.1 General – Installation of Field Components and Instruments

.1 The control drawings and/or control sequences indicate only the principal items of equipment controlling the systems. Supplement each control system with all devices (e.g. relays) gauges and auxiliaries required to enable each system to perform as specified and to permit proper operation and supervision of same.

.2 Upon completion of the Work, all control devices shall be calibrated, tested and verified, as required, to place the system in complete and satisfactory operating condition.

.3 Notify the Contract Administrator in writing of any conflict between these Specifications and the manufacturer's instructions.

.4 All equipment installed shall be mechanically stable and, as necessary, fixed to floor or wall. Anti-vibration mounts to be provided, where required, for the proper isolation of equipment.

.5 Install equipment to allow for ease of maintenance access such that it does not interfere in any way with access to adjacent equipment and personnel traffic in the surrounding space.

.6 Install equipment in locations having suitable ambient conditions for its specified functioning, allowing for adequate ventilation and the prevention of condensation traps.

.7 Ensure that all holes drilled in ductwork and HVAC equipment housings are properly sealed to eliminate leakage and to maintain the pressure rating of the equipment in question.

3.2 Temperature Sensors and Thermowells

.1 Provide mixed air temperature sensors of a sufficient length to give an accurate temperature indication for the cross section of mixing plenum or duct involved. Install sensors in a serpentine arrangement about the plane of stratification (horizontal or vertical) so that an equal length of the sensing element covers an equal area of the mixing plenum and an accurate measurement of the mixed air temperature is achieved.

.2 Unless otherwise indicated in the Contract Documents, mount space sensors 1500 mm above the finished floor level. Confirm exact location of all thermostats prior to roughing-in.

.3 In process/service areas, utility rooms and other areas where the thermostat might be subject to damage, provide a metal cage or cast aluminum thermostat guard.

.4 Drill holes, weld thread-o-lets and mount thermowells in piping after isolating and draining the section to be worked on. Notify the Contract Administrator before doing so. Install sensors in thermowells with dust-tight connection heads. Ensure sensor element is immersed in heat transfer compound and firmly seated against tip of well. Element shall extend at least two thirds of the pipe diameter into the pipe. Install sensor in region of piping where well-mixed conditions exist (e.g. at a pipe bend) wherever possible. Where pipe diameter is less than the length of the sensing element, mount sensor at piping elbow. Use stainless steel thermowells with extensions, where required, to accommodate thickness of insulation. Replace and repair insulation and pipe jacketing to return to original condition.

3.3 Installation of Direct Digital Control System Components

.1 Provide all control (including 120 V where indicated on the Drawings) and power wiring, including installation required to interconnect control components located on air handling units and power wiring between lighting panel circuits provided under Division 26 and field-mounted controllers . Refer to electrical wiring diagrams for details regarding interconnection wiring requirements with control components.

.2 Sensor and control device wiring are to be as recommended by the control system manufacturer.

.3 Provide all contacts and interfaces required for pickup of alarm and status points for systems and equipment other than the PCS controlled devices as indicated on the Drawings.

3.4 Installation of Dampers and Operators

.1 Provide the required number of electric operators to properly drive all system dampers. Check and test operation, and adjust as required.

.2 Securely mount operators on damper frames to withstand counter torque created by dampers.

.3 Install at locations indicated on the Drawings and in accordance with the manufacturer's instructions.

.4 Install square and free from racking with blades running horizontally.

.5 Operate opposed blade dampers from a power blade or drive axle.

.6 Bracing:

.1 Install for multiple section assemblies to support assembly weight and to hold against system pressure.

.2 Install at every horizontal and vertical mullion.

3.5 Installation of Thermostats

.1 Unless otherwise specified in the Contract Documents, provide all required line voltage thermostats, including those for unit heaters and fan coils.

.2 In process areas, utility rooms and other areas where the thermostat might be subject to damage provide a metal cage or cast aluminum thermostat guard.

.3 Unless otherwise indicated in the Contract Documents, mount room thermostats 1500 mm above the finished floor level. Confirm exact location of all thermostats prior to roughing-in.

.4 Provide stand-off mounting and an insulated sub-base for thermostats on outside walls.

3.6 Installation of High and Low Temperature Detectors, and Accessories

.1 Place where indicated on the control Drawings.

.2 Element shall be mounted across duct to in a serpentine arrangement about the plane of stratification (horizontal or vertical) so that an equal length of the sensing element covers an equal area of the mixing plenum and an accurate measurement of temperature is achieved.

3.7 Installation of Control Component Panels

.1 Provide at locations indicated on the Drawings or implied by the Drawings and Control Specifications. Locate panels to provide a convenient operator interface with control system.

.2 Surface wall mount or secure in place between free-standing galvanized structural steel members.

.3 Confirm exact cabinet locations prior to roughing-in.

3.8 Closeout Activities

.1 Provide in accordance with Section 01 78 00.

END OF SECTION

SEQUENCE OF OPERATIONS FOR HVAC DDC

1. GENERAL

1.1 Description

.1 Provide control sequences for DDC for HVAC systems, subsystems, and equipment as indicated and in compliance with Contract Documents.

.2 This specification is to be read in conjunction with relevant equipment specifications with particular attention to controls.

.3 The relevant Process & Instrumentation Diagrams for HVAC are to be reviewed for congruence with the described control sequences. Conflicts or discrepancies are to be identified and reported to the Contract Administrator for clarification prior to tender closing.

1.2 Definitions

.1 Analog Output: Proportional output signal (4 to 20 mA).

.2 Binary Output: On/off output signal or contact closure.

.3 DDC: Direct digital control.

.4 Digital Output: Data output that must be interpreted digitally.

.5 PCS: Plant Control System.

.6 HMI: Human-Machine Interface.

.7 VFD: Variable Frequency Drive.

.8 ACH: Air changes per hour.

1.3 Submittals

.1 Submit the following shop drawings in accordance with Section 01 33 00.

.2 Product Data:

.1 An instrumentation list for each controlled system. Label each element of the controlled system in table format. Show, in the table element name, type of device, manufacturer, model number, and control device product data sheet number.

.2 A complete description of the operation of the control system, including sequences of operation. Include and reference a schematic diagram of the controlled system.

.3 Shop Drawings:

.1 Riser diagrams showing control network layout, communication protocol, and wire types.

.2 Schematic diagram of each controlled system. Include all control points labeled with point names shown or listed. Show the location of control elements in the system.

.3 Wiring diagram for each controlled system. Show all control elements labels. Where a control element is the same as that shown on the control system schematic, label with the same name. Label all terminals.

1.4 Spare Parts

.1 Comply with the requirements specified in Section 01 61 00.

1.5 Quality Assurance

.1 Comply with the requirements specified in Section 01 45 00.

.2 See Section 1.1.2 and 1.1.3 above.

1.6 Delivery Storage and Handling

.1 Comply with the requirements specified in Section 01 61 00.

1.7 Operating Modes

.1 The HVAC systems will have the following two operating modes selected through the HMI by an operator:

.1 Summer mode.

.2 Winter mode.

1.8 Glycol Heating System

.1 Summer mode: Glycol heating system OFF.

.2 Winter mode: Glycol heating system ON and to operate as follows:

.1 Heat is provided to the building from the district hot water system through two (2) duty / standby plate and frame heat exchangers. Heat is transferred to a 50% propylene glycol mixture pumped throughout the building.

.2 There are two (2) duty / standby circulation pumps (P-P6610 and P-P6620) on the district hot water side configured to draw in hot water supply from the district system, drive it through the heat exchangers (HE-P6601 and HE-P6602) where it transfers heat to the building’s 50% propylene glycol circuit, and returns it to the district system.

.3 The Scum Dewatering Building distribution system consists of a circulation circuit driven by pumps P-P6630 and P-P6640 in a duty / standby configuration. The speed of these pumps is controlled via “sensorless” control integral to the pumps. The PCS retains on/off and fault monitoring control of the pumps, operator adjustable speed setpoint and speed feedback is provided to control pump speed in remote operation.

.4 The building’s 50% propylene glycol circuit feeds all energy recover ventilators, make-up air units, air handling units, force flow units and hydronic unit heaters directly with each device having a dedicated flow control valve.

.5 Normal Operation/Start-Up Sequence:

.1 The PCS shall provide the duty unit of hot water pumps P-P6610 and P-P6620 with a start signal.

.2 The PCS shall command the duty unit of glycol circuit circulation pumps P-P6630 and P-P6640 to start with the hot water pumps.

.3 The PCS shall provide alternating control logic to ensure all pumps have equal run time. The alternating control can be manually overridden by the PCS or by an operator putting the pump in the “off” or “hand” condition at the MCC panel.

.4 The PCS shall monitor the pump controllers for fault signals. If a fault signal is received, the PCS shall generate an alarm at the PCS.

.5 The PCS shall determine the required glycol circuit temperature based on an outdoor air schedule, or by monitoring all zone and discharge temperatures and motorized valve positions to determine if the circuit’s glycol temperature set point should be adjusted. If any of the valves are 100% open the glycol temperature will be increased by 5°C. If any of the valve positions are more than 75% open after a predetermined length of time the supply temperature will be increased by an additional 2°C and so on until all control valves are less than 75% open and all temperature set points are satisfied. The glycol circuit temperature may also be adjusted manually by an operator.

.6 The PCS shall monitor all zone and discharge temperatures and motorized valve positions to determine if the circuit’s glycol temperature set point should be adjusted. If all valves are less than 50% open and all set points are satisfied the glycol temperature will be decreased by 5°C. If all valve positions are less than 75% open after a predetermined length of time the supply temperature will be decreased by an additional 2°C and so on until at least one control valve is more than 75% open and all temperature set points are satisfied.

.7 Based on the monitored temperature of the glycol supply and the control set point generated by the PCS, a motorized three-way mixing valve under control of the PCS will control the temperature of the hot water supplied to heat exchangers HE-P6601 and HE-P6602 in order to achieve setpoint.

1.9 Energy Recovery Ventilator Unit Control Sequences – Process Areas

.1 AHU-P6100 and AHU-P6200:

.1 AHU-P6100 and AHU-P6200 to normally operate in parallel. In the event one unit fails, the other is to operate at high speed. Two modes of fan operation:

.1 Reduced (normal) speed.

.2 High speed.

.2 The press process area is an electrically hazardous area due to the potential presence of combustible gases. As defined by NFPA 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities the classification of the space is Class 1

Division 2. Provided there is continuous mechanical ventilation at 12 air changes per hour (ACH) this area can be considered de-classified per NFPA 820.

.3 Both ERVs, AHU-P6100 and AHU-P6200, will operate at high speed, in parallel, to deliver 12 ACH (see ERV equipment schedule) when the outdoor temperature is above 10°C, the building is occupied or when the combustible or H2S gas detection is in alarm.

.4 When the building is unoccupied, the outside air 9°C or less and H2S and combustible gas levels are below the alarm levels the ERVs will operate in parallel to deliver approximately 6 ACH (50% of maximum airflow rate in ERV equipment schedule). If any of these conditions are violated the ERVs will automatically revert to delivering 12 ACH.

.5 Occupancy for the loading bay, dewatering room, and basement will be determined by either occupancy sensors or light switches being turned ON – either scenario will force ERVs to run at 12 ACH for a period of three (3) hours (adjustable). Ten (10) minutes (adjustable) prior to reverting to the unoccupied ventilation rate of 6 ACH, the control system will activate warning lights in the space to allow occupants to either trigger the occupancy sensors or turn ON a light switch to initialize another three (3) hours of 12 ACH. The warning lights will be de-energized immediately when this occurs. Identifying signage will be posted at each switch and warning light.

.6 On a start command from the Plant Control System (PCS), isolation dampers XV-P61001 and XV-P62001 on the units' supply ducts will be driven open and isolation dampers XV-P61002 and XV-P62002 on the units' return ducts will be driven open. A confirmation signal sent to the PCS indicating the dampers are fully open will be required prior to starting the ERV's supply and exhaust fans.

.7 The supply fans' variable frequency drives (VFD) will be adjusted through the PCS to maintain a constant air delivery volume as measured at the airflow measuring stations (AMS) in the unit's discharge ductwork. The airflow set point will be determined based on the parameters stated above.

.8 The ERV's exhaust fan's variable frequency drive will be adjusted through the PCS to maintain a constant space pressure within the Loading Bay area of negative 25 Pa (0.10 inches water gage) referenced to ambient outdoor air pressure. A space pressure sensor shall provide an analog signal to the PCS indicating the space differential pressure with respect to outdoors on a continuous basis. PID tuning loops shall be used to dampen sudden fluctuations and to limit ramp speed changes on the exhaust fan VFD.

.1 An end switch on the overhead doors in the Loading Bay will temporarily pause the space differential pressure control while either overhead doors are open holding the ERV exhaust fans speed at the last value before the control is paused. After the overhead doors have been confirmed closed and a time delay initially set at 10 minutes (adjustable) has elapsed, the space differential pressure control will resume the control of ERVs speed and maintain pressure setpoint.

.9 The ERV heat exchanger damper controls are packaged with the ERV unit and normally operate independent from the PCS to cycle the internal flow-directing dampers.

.10 The supply air stream temperature leaving each ERV unit will be monitored by an averaging sensor and will be displayed on the PCS control screen and logged in the historical database.

.11 The air flow rate of the supply fan in the ERV unit will be monitored by an averaging sensor and will be displayed on the PCS control screen and logged in the historical database.

.12 In all shutdown cases the fans will be de-energized and a time delay of forty (40) seconds (adjustable) provided before the isolation dampers are commanded closed in order to prevent excessive backpressure as the fans slow.

.13 Summer mode: The motorized valves serving the glycol heating coils will be CLOSED.

.14 Winter mode:

.1 The ERV's integral hydronic coil will be controlled in parallel from space temperature sensors as an over-ride to discharge temperature control. Normal control will cause the discharge air from ERV to be a minimum of 15°C and will be over-ridden when the space calls for additional heat to maintain the space temperature due to heat loss or infiltration.

.2 When the ambient outdoor air temperature is below 10°C, the ERV unit control panels will maintain a constant discharge temperature initially set at 15°C by modulating the motorized valves serving the glycol heating coils (TV-61006 for AHU-P6100, TV-62004 for AHU-P6200) based on the input from a discharge sensor and set point signal from the PCS system.

.15 If the space temperature in any room exceeds 40°C a high temperature alarm will be generated at the PCS.

.16 If the space temperature in any room drops below 8°C a low temperature alarm will be generated at the PCS.

.17 A freeze protection control integral to the ERV's controller will shut the unit down on a discharge temperature below 4°C.

.18 When the differential pressure across a filter bank exceeds 7% of the maximum filter pressure drop rating the differential pressure instrument input for the respective filter will generate an alarm in the PCS that will be logged and annunciated on the control system.

1.10 Air Handling Unit Control Sequences

.1 Air Handling Unit AHU-P6400 – Electrical Room:

.1 The air handling unit will be started via the PCS based on scheduling to be determined by the City (initially set to run continuously).

.2 On start of the air handler's supply fan, the return air damper will be fully open and outside air damper fully closed.

.3 Summer mode:

.1 Mode will be determined by PCS.

.2 The motorized valve serving the glycol heating coil will be CLOSED.

.3 The unit controller will use an integral discharge setpoint that is adjustable between upper and lower limits in the unit controller, to sequence economizer and stages of mechanical cooling (CU-P6400) to maintain the required discharge and space air temperature provided by PCS to unit controller. Compressor(s) cycle has minimum run time, minimum off time and interstage timing.

.4 Outside air damper reverts to minimum position when:

.1 Outside air temperature is above 21°C.

.2 Mechanical cooling is on.

.3 Unit is off.

.5 Mechanical cooling is locked out when outside air temperature is below 10°C.

.4 Winter mode:

.1 When the ambient outdoor air temperature is below 10°C measured by the integral unit temperature sensor and winter mode is selected(activated) through the HMI, the PCS will maintain a constant discharge temperature initially set by modulating the motorized valve TV-P64006 serving the glycol heating coil based on the input from a discharge sensor and set point signal from the PCS system determined by the space temperature. TV-P64006 will only start modulating once the unit outside air damper is minimum open position detected by the position feedback to PCS.

.2 In the event the Electrical Room space temperature drops below 16°C the air handler's discharge air temperature will be adjusted upward proportionally to the error from the set point by first modulating the dampers and secondly opening the heating coil supply valve.

.3 Upon the space temperature in the Electrical Room exceeding 18°C the air handler's discharge temperature will be decreased proportionally to the error by modulating motorized heating coil valve closed. The minimum discharge air temperature will be 13°C.

.4 If the Electrical Room space temperature is above 24°C with modulating motorized heating coil valve fully closed, the outside air damper will be modulated open from its minimum position with the return air damper modulating closed to achieve a discharge air temperature proportional to the temperature error from setpoint with a minimum limit of 13°C discharge temperature.

.5 The PCS will monitor the space temperature in Electrical Room and adjust the discharge air temperature proportionally to the error from setpoint.

.6 Space temperature set point for the Electrical Room will be 18°C (adjustable).

.7 As the Outside air damper opens, the relief air damper PV-P64008 will be modulated open by the PCS to maintain a positive space pressure of 25 Pa (0.1 inches water gage) relative to adjacent spaces. The pressure reset function will delay or slow response to avoid reactions to momentary changes in adjacent spaces.

.8 If the space temperature in the Electrical Room exceeds 30°C a high temperature alarm will be generated in the PCS.

.9 If the space temperature in the Electrical Room drops below 8°C a low temperature alarm will be generated in the PCS.

.10 In the event of a lost PCS signal, the unit controller will revert to the integral heating or cooling setpoint.

.11 Pressure drop across the air filters will be continuously monitored with an alarm being initiated in the PCS if the pressure drop exceeds a predetermined set point. The pressure drop of the filter at the alarm point is not to affect the airflow by more than 10% of design. The set point of the alarm is to be provided by the air handler manufacturer based on the unit's fan performance and the performance of the specified filter.

1.11 Make-Up Air Unit Control Sequences

.1 Make-Up Air Unit AHU-P6300 – Polymer Room and Mechanical Room:

.1 Make-up air unit will be started in the following order via the PCS based on scheduling to be determined by the City (initially set to run continuously).

.2 Inlet damper shall be energized to open and proven to be open.

.3 Exhaust fan EF-P6300 and make up air unit AHU-P6300 shall be started.

.4 Mechanical Room to have constant air supply (not controlled).

.5 Summer mode: The motorized valve serving the glycol heating coil will be CLOSED.

.6 Winter mode:

.1 When the ambient outdoor air temperature is below 18°C the unit control panel will maintain a constant discharge temperature, initially set at 18°C, by modulating the motorized valve TV-P63004 serving the make-up air unit's glycol heating coil based on the input from a discharge sensor and set point signal from the PCS.

.2 The PCS will monitor the space temperature in Polymer Room.

.3 The lower space temperature setpoint will be 18°C.

.4 When the glycol heating system is in operation and the Polymer Room space temperature drops below 18°C the make-up air unit's discharge air temperature will be adjusted upward proportionally to the error from the set point by opening the heating coil supply valve.

.5 If the space temperature goes above 19.5°C the discharge temperature setpoint of the make-up air unit will be decreased proportionally until the glycol coil control valve is fully closed. The minimum discharge air temperature will be 13°C.

.7 The space temperature set point for the unit heaters in the spaces will be 18°C.

.8 If the space temperature in either room exceeds 40°C a high temperature alarm will be generated at the PCS.

.9 If the space temperature in the either room drops below 8°C a low temperature alarm will be generated at the PCS.

.10 Pressure drop across the air filters will be continuously monitored with an alarm being initiated to the PCS if the pressure drop exceeds a predetermined set point. The pressure drop of the filter at the alarm point is not to affect the airflow by more than 10% of design. The set point of the alarm is to be provided by the air handler manufacturer based on the unit's fan performance and the performance of the specified filter.

1.12 Exhaust Fan Control Sequences

.1 To be interlocked to start with AHU-P6300 and run continuously.

1.13 Hydronic Heater Control Sequences

.1 Unit Heater / Force Flow Heater, Hydronic:

.1 Summer mode: The motorized valves serving the hydronic heaters will be CLOSED.

.2 Winter mode: Hydronic heaters to operate as follows:

.1 The space temperature set point for the unit heaters in the spaces will be 18°C (adjustable). Dead band will be determined during commissioning.

.2 PCS will energize hydronic valve and start unit heater fan simultaneously based on setpoint temperature.

.3 Upon loss of PCS communication, backup space thermostat associated with the heaters will operate the heaters to maintain the space temperature to the desire setpoint of the thermostat. 7.5°C (adjustable). Factory fixed dead band is provided with the thermostat.

.3 Space Temperature:

.1 Primary Input:

.1 Device: PCS input via space temperature sensor.

.2 Location: Space.

.2 Backup Input:

.1 Device: Thermostat.

.2 Location: Space.

.3 Output Device:

.1 Device: Unit heaters.

.2 Location: space.

.3 Transference: start signal relay.

.4 Output Device:

.1 Device: Binary output.

.2 Location: Control valve.

.3 Transference: Control-valve actuator.

.5 Action: Cycle fan and valve in unison to maintain space temperature at setpoint.

1.14 Scale Pit Sump Pump

.1 The pump is powered through the pump switch. The pump switch includes the audible and visual alarms and interface with the PCS. The alarm system shall alert the building operators of a high level of liquid present.

.2 This system is a self-contained control system for operating the sump pump. The system includes start and stop controls, and the following probes:

.1 High level probe.

.2 Pump start/stop probe.

.3 Sequence of Operation:

.1 On rise in liquid level, when the water level reaches the “start pump” probe level, a relay contact will close, starting the pump. The pump will remain in operation until the water level reaches the “pump stop” probe level. If the liquid level rises again to the “start pump” probe level, the pump will be re-started and the cycle will continue.

.2 If the liquid level reaches the “high level” probe level, the “high water” alarm light will illuminate on the alarm panel, a red beacon will flash, and an audible alarm will be activated and the remote alarm will activate.

.3 The control panel is provided with “power”, “pump run”, and “high water” led indicators.

.4 The audible alarm is provided with a “test” and a “silence” push-button on the alarm panel.

.4 PCS Interface and Monitoring:

.1 The PCS system will monitor a “High Liquid” alarm point.

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

END OF SECTION

1. GENERAL

1.1 Related Requirements

.1 Section 21 05 01 - Common Work Results for Mechanical.

1.2 References

.1 American National Standards Institute/American Water Works Association (ANSI/AWWA):

.1 ANSI/AWWA C111/A21.11-06, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.2 American Society of Mechanical Engineers (ASME):

.1 ASME B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

.2 ASME B16.3, Malleable Iron Threaded Fittings: Classes 150 and 300.

.3 ASME B16.5, Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch Standard.

.4 ASME B16.9, Factory-Made Wrought Buttwelding Fittings.

.5 ASME B18.2.1, Square Hex, Heavy Hex and Askew Head Bolts and Hex, Heavy Hex, Hex Flange. Lobed Head and Lag Screws (Inch Series).

.6 ASME B18.2.2, Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).

.7 ASME B36.19M, Stainless Steel Pipe.

.3 ASTM International:

.1 ASTM A312/A312M-22a, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.

.2 ASTM A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.

.3 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.

.4 ASTM A536, Standard Specification for Ductile Iron Castings.

.5 ASTM B61, Standard Specification for Steam or Valve Bronze Castings.

.6 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.

.7 ASTM E202, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.

.8 ASTM D1622, Standard Test Method for Apparent Density of Rigid Cellular Plastics.

.9 ASTM D2842, Standard Test Method for Water Absorption of Rigid Cellular Plastics.

.10 ASTM D6226, Standard Test Method for Open Cell Content of Rigid Cellular Plastics.

.4 CSA International:

.1 CSA W48, Filler Metals and Allied Materials for Metal Arc Welding.

1.3 Action and Informational Submittals

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for hydronic systems and include product characteristics, performance criteria, physical size, finish, and limitations.

.3 Shop Drawings:

.1 Indicate on drawings:

.1 Components and accessories.

1.4 Closeout Submittals

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

.2 Operation and Maintenance Data: submit operation and maintenance data for hydronic systems for incorporation into manual.

1.5 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 01 60 10 - Materials and Equipment and with manufacturer's written instructions.

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

.3 Storage and Handling Requirements:

.1 Store materials off ground and in a dry location in accordance with manufacturer's recommendations.

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

.3 Replace defective or damaged materials with new.

2. PRODUCTS

2.1 Interior Pipe

	Service	Material

	Service	Material
.1	Hot water and glycol heating to 120°C (250°F)	Steel, Sch.40, ASTM A53, Grade B heating to 120°C (250°F)
.2	Equipment drains and overflows	Sch.40, galvanised steel, ASTM A120 Type L hard copper ASTM B88M

2.2 Buried Exterior Pipe

	Service	Material
.1	Buried hydronic piping up to 120°C (250°F)	316L Stainless Steel, Sch. 40, ASTM A312. Factory insulated, refer to section 2.2.2.

.2 Factory insulated pipe assembly:

.1 Pipe:

.1 Per Section 2.2.1.

.2 Insulation:

.1 Rigid polyurethane foam, factory applied.

.2 Thickness: 50 mm or as required.

.3 Density: 35 to 48 kg/m³, per ASTM D1622.

.4 Closed cell content: 90% minimum, per ASTM D6226.

.5 Water absorption: maximum 4.0% by volume, per ASTM D2842.

.6 Pipe joints: pre-fabricated rigid polyisocyanurate or polyurethane foam half shells, sealed with suitable wrap around adhesive lined heat shrink sleeves.

.7 Fittings: rigid polyisocyanurate or polyurethane foam half shells with a fully bonded polymer protective coating on all exterior and interior surfaces, including ends. All insulation kits shall be complete with silicone caulking for seams, stainless steel bands and gear clamps.

.3 Jacket:

.1 Polyethylene, UV inhibited, formulated for superior cold environment properties.

.2 Sealant: Butyl rubber and resin, applied hot in 0.63 mm multiple layers providing a shrink tightened waterproof bond throughout its entire length.

.4 Acceptable product: URECON U.I.P. or approved equal.

2.3 Pipe Joints

.1 NPS 2 and under: screwed fittings with PTFE tape or lead-free pipe dope.

.2 NPS 2-1/2 and over: welding fittings and flanges to CSA W48.

.3 Flanges: plain or raised face, weld neck to ANSI/AWWA C111/ A21.11.

.4 Orifice flanges: slip-on raised face, 2100 kPa.

.5 Flange gaskets: to ANSI/AWWA C111/ A21.11.

.6 Pipe thread: taper.

.7 Bolts and nuts: to ASME B18.2.1 and ASME B18.2.2.

.8 All buried piping joints to be welded.

2.4 Fittings

.1 Screwed fittings: malleable iron, to ASME B16.3, Class 150.

.2 Pipe flanges and flanged fittings:

.1 Cast iron: to ASME B16.1, Class 125.

.2 Steel: to ASME B16.5.

.3 Butt-welding fittings: steel, to ASME B16.9.

.4 Unions: malleable iron, to ASTM A 47M and ASME B16.3.

.5 Stainless steel fittings to ASME B36.19.

3. EXECUTION

3.1 Examination

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

.1 Visually inspect substrate in presence of Contract Administrator.

.2 Inform Contract Administrator of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Contract Administrator.

3.2 Piping Installation

.1 Install pipework in accordance with Section 23 05 05 - Installation of Pipe Work.

.2 System requires a Canadian Registration Number (CRN).

3.3 Circuit Balancing Valves

.1 Install flow measuring stations and flow balancing valves as indicated.

.2 Remove handwheel after installation and when TAB is complete.

.3 Tape joints in prefabricated insulation on valves installed in chilled water mains.

3.4 Cleaning

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools, and equipment.

3.5 Protection

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by hydronic systems installation.

END OF SECTION

HYDRONIC SPECIALTIES

1. GENERAL

1.1 Scope

.1 Expansion Tanks – Bladder Type.

.2 Manual air vents.

.3 Air separators.

.4 Relief valves and fittings.

.5 Combination Low Pressure Relief and Reducing Valve.

.6 By-pass filter.

.7 Chemical pot feeder.

.8 Sight Flow Indicator.

.9 Pipe Line Strainer.

.10 Propylene Glycol Solution.

1.2 Action and Informational Submittals

.1 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for expansion tanks, air vents, separators, valves, and strainers and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 Closeout Submittals

.1 Submit maintenance and operation data for inclusion in the maintenance manual.

1.4 Delivery, Storage and Handling

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

2. PRODUCTS

2.1 Expansion Tanks – Bladder Type

.1 Vertical steel pressurized bladder type expansion tank.

.2 Capacity: as scheduled.

.3 Bladder sealed in EPDM suitable for 115°C operating temperature.

.4 Working pressure: 860 kPa with ASME stamp and certification.

.5 Air precharged to 84 kPa (initial fill pressure of system).

.6 Base mount for vertical installation.

.7 Removable bladder.

2.2 Manual Air Vents

.1 Provide manual air vents with 25 mm or line diameter pipe whichever is greater to form air collection chamber. Collection chamber to be 150 mm high.

2.3 Air Separators

.1 Centrifugal type with 861 kPa WSP steel tank, galvanized steel 5 mm perforated strainer, perforated stainless steel air collector tube and drain connection.

.2 Inlet and outlet flanges line size.

2.4 Combination Low Pressure Relief and Reducing Valve

.1 Adjustable pressure setting: 206 kPa relief, 55 to 172 kPa reducing.

.2 Low inlet pressure check valve.

.3 Removable strainer.

2.5 Bypass Filter

.1 Unit to consist of cartridge filter, flow indicator, flow control valves and filter cartridges. Cartridge filter; stainless steel shell of single centre bolt construction with cast nick-plated brass head, drain plug and air vent. Flow indicator - cast bronze body with two sight glasses of high temper, thermo shock-resistant glass and nylon rotor on stainless steel pin.

.1 Flow Control Valves: Cast Bronze Globe Valves, 25 mm Female NPT.

.2 Filter cartridges: 10 each of 10 micron retention, and 20 micron retention.

.3 Manufacturer: Guthrie Hydroniclean System.

2.6 Chemical Pot Feeder

.1 150 mm diameter x 550 mm long feeder, suitable for 861 kPa (125 psi) operating pressure complete with isolation valves on 20 mm inlet and outlet lines, 20 mm drain valve, 40 mm fill complete with filling funnel.

2.7 Sight Flow Indicator

.1 Provide sight flow indicator with tempered glass viewing window, bronze body, ABS impeller, temperature rated to 93°C, pressure rated to 8.62 bar and threaded connection.

.2 Manufacturer: W.E. Anderson Midwest SFI-100.

2.8 Pipe Line Strainer

.1 NPS 13 to 50: bronze body to ASTM B 62, screwed connections, Y pattern.

.2 NPS 65 to 300: cast steel body to ASTM A 278/A278M, flanged connections.

.3 Blowdown connection: NPS 25.

.4 Screen: stainless steel.

.5 Working pressure: 860 kPa.

2.9 Glycol Solution

.1 Provide propylene glycol/water solution suitable for the temperature range of heating system. Solution to be suitable for heating complete with appropriate corrosion inhibitors. Solutions must be factory premixed to a concentration of 50% by volume.

2.10 Glycol Feed Tank

.1 Pre-mix solution in mixing tank and charge system using feed pump. After system has been filled, check specific gravity of solution in each system. Leave mixing tank filled with specified glycol solution. Secure cover lid.

.2 Glycol Feed System: Automatic feed system, comprising the following:

.1 Pump: 3.8 L/min. at 345 kPa, 115/1/60 VAC, with thermal cut-out, plug, and cord, capable of running dry without damage.

.2 Tank: polyethylene tank with level gauge, cover, pump suction hose with strainer, low level pump cut-out, diverter valve for air purging and agitation, and all required connections. Mount on platform with casters.

.3 Pressure Regulating Valve: Glycol addition is to be controlled by an adjustable pressure reducing valve, range 35-380 kPa, complete with pressure gauge, strainer, check valve, union connection and 12 mm x 900 mm flexible outlet hose with check valve.

.4 Accumulator Tank: Pre-charged accumulator tank with EPDM diaphragm.

.5 Alarm Panel: Low level alarm panel, complete with remote monitoring contacts and selectable audio alarm, and dry contact for remote alarm monitoring.

.3 Unit shall be completely pre-assembled and certified by a recognized testing agency to CSA standard C22.2 No.68.

.4 Acceptable Manufactures:

.1 Axiom Industries Ltd.

.2 A&F Machine Products Co.

.3 Armstrong.

.4 Bell and Gossett.

.5 Or approved equivalent.

3. EXECUTION

3.1 Application

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

3.2 General

.1 Run drain lines and blow off connections to terminate in glycol makeup tank.

.2 Maintain adequate clearance to permit service and maintenance.

.3 Should deviations beyond allowable clearances arise, request and follow Contract Administrator's directive.

.4 Check Shop Drawings for conformance of tappings for ancillaries and for equipment operating weights.

3.3 Strainers

.1 Install in horizontal or down flow lines.

.2 Ensure clearance for removal of basket.

.3 Install ahead of each pump.

.4 Install ahead of each automatic control valve larger than NPS 1 and as indicated.

3.4 Air Vents

.1 Install at high points of systems.

.2 Install gate valve on automatic air vent inlet. Run discharge to glycol makeup tank.

3.5 Expansion Tanks

.1 Adjust expansion tank pressure as indicated.

.2 Install lockshield type valve at inlet to tank.

3.6 Pressure Safety Relief Valves

.1 Run discharge pipe to terminate in glycol makeup tank.

3.7 Cleaning

.1 Remove surplus materials, excess materials, rubbish, tools, and equipment.

END OF SECTION

HYDRONIC PUMPS

1. GENERAL

1.1 Scope of Work

.1 The Scope of Work for this Section includes, but is not limited to, the following:

.1 Materials and procedures for the provision and installation of hydronic pumps and related accessories.

1.2 Related Work

.1 This Section may not contain all materials, equipment and requirements required for the completion of this project. This Section is to be read in conjunction with the relevant Sections of Division 21, 22, 23, and 26 and all related works.

.2 Division 1 forms an integral part of Division 21, 22 and 23 related requirements.

1.3 References

.1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE):

.1 Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 CSA B214: Installation code for hydronic heating systems.

.3 Electrical Equipment Manufacturers Advisory Council (EEMAC).

1.4 Action and Informational Submittals

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for pump, circulator, and equipment, and include product characteristics, performance criteria, physical size, finish and limitations indicate point of operation, and final location in field assembly.

.3 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.

1.5 Closeout Submittals

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

1.6 Maintenance

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

1.7 Delivery, Storage and Handling

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

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

2. PRODUCTS

2.1 Equipment

.1 Size and select components to CSA-B214.

2.2 Vertical In-Line Circulators – Sensorless Flow Control

.1 Close-coupled, inline for vertical or horizontal installation.

.2 Cast iron construction.

.3 Suitable standard operations at 107°C and 1200 kPag working pressure. Working pressures not de-rated at temperatures up to 107°C.

.4 Pump internals capable of being serviced without disturbing piping connections.

.5 Solid alloy steel shaft integral to motor. Non-ferrous shaft sleeve employed to completely cover the wetted area under the seal.

.6 Motor bearings support shaft via heavy-duty, grease lubricated ball bearings.

.7 Mechanical seal assembly internally flushed and installed in an enlarged tapered seal chamber complete with stainless steel housing, Buna bellows and seat gasket, stainless steel spring, and be carbon ceramic design with carbon face rotating against stationary ceramic face.

.8 Stainless steel impeller keyed to shaft and secured by stainless steel locking capscrew or nut.

.9 Impeller hydraulically and dynamically balanced to Hydraulic Institute Standards.

.10 Pump volute Class 30 cast iron design with integral cast iron flanges drilled for 125# ANSI companion flanges. Include gauge ports at nozzles, vent and drain ports. Volute designed with base ring matching ANSI 125# flange to simplify pump support.

.11 Motor:

.1 Power, speed, and voltage as scheduled.

.2 Heavy-duty grease lubricated ball bearings.

.3 Non-overloading at any point on the pump curve and meet NEMA specifications.

.12 Controls:

.1 Variable speed pump with integrated sensorless load demand based control.

.2 Factory mounted, wired, with a disconnect switch and menu-driven graphical interface.

.3 Provide near unity displacement power factor (cos Ø) without need for external power factor correction capacitors at all loads and speeds using VVC-PWM type integrated controls.

.4 Includes dual DC link reactors equivalent to 5% impedance line reactors, for reduction of mains borne harmonic currents and DC link ripple current to increase DC link capacitor lifetime.

.5 EMI/RFI filters conforming to DIN EN61800-3 to ensure integrated controls meets low emission and immunity requirements.

.6 System pressure to be maintained at 10 m (adj.) head minimum.

.7 Supports direct communication with the building management system (BMS) with built-in support for BACnet™ MS/TP protocol.

.8 Enclosure rated to UL Type 12 suitable for indoor operation.

.9 Supports programmable skip frequencies and adjustable switching frequency for noise and vibration control.

.10 Provide a temperature controlled fan for cooling of the heat sink in the back panel.

.11 Rated to operate in ambient working conditions of minus 10°C to 45°C.

.12 Inputs and Outputs:

.1 Two (2) analog inputs (current or voltage).

.2 One (1) current output.

.3 Six (6) programmable digital inputs with 2 configurable as outputs.

.4 Supports two (2) programmable pulse inputs and two (2) programmable relay outputs.

.5 One (1) RS485 communication port.

.13 Software capable of sensorless control in variable volume systems without need for pump mounted (internal/external) or remotely mounted differential pressure sensor.

.14 Operates under quadratic pressure control (QPC) to ensure head reduction with reducing flow conforms to quadratic control curve.

.15 Supports a minimum head of 40% of design duty head.

.16 Provide user adjustable control mode settings and minimum/maximum head set points using built-in programming interface.

.17 Software capable of controlling pump performance for non-overloading power at every point of operation.

.18 Software capable of maintaining flow rate data.

.13 Factory tested and name-plated before shipment.

.14 Acceptable product:

.1 Armstrong design envelope sensorless 4380.

.2 Or approved equivalent.

2.3 Vertical In-Line Circulators – Constant Speed

.1 Close-coupled, inline for vertical or horizontal installation.

.2 Cast iron construction.

.3 Suitable standard operations at 107°C and 1200 kPag working pressure. Working pressures not de-rated at temperatures up to 107°C.

.4 Pump internals capable of being serviced without disturbing piping connections.

.5 Solid alloy steel shaft integral to motor. Non-ferrous shaft sleeve employed to completely cover the wetted area under the seal.

.6 Motor bearings support shaft via heavy-duty, grease lubricated ball bearings.

.7 Mechanical seal assembly internally flushed and installed in an enlarged tapered seal chamber complete with stainless steel housing, Buna bellows and seat gasket, stainless steel spring, and be carbon ceramic design with carbon face rotating against stationary ceramic face.

.8 Stainless steel impeller keyed to shaft and secured by stainless steel locking capscrew or nut.

.9 Impeller hydraulically and dynamically balanced to Hydraulic Institute Standards.

.10 Pump volute Class 30 cast iron design with integral cast iron flanges drilled for 125# ANSI companion flanges. Include gauge ports at nozzles, vent and drain ports. Volute designed with base ring matching ANSI 125# flange to simplify pump support.

.11 Motor:

.1 Power, speed, and voltage as scheduled.

.2 Heavy-duty grease lubricated ball bearings.

.3 Non-overloading at any point on the pump curve and meet NEMA specifications.

.12 Factory tested and name-plated before shipment.

.13 Acceptable product:

.1 Armstrong 4380.

.2 Or approved equivalent.

3. EXECUTION

3.1 Application

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

3.2 Installation

.1 Install pumps to CSA-B214.

.2 In line circulators: install as indicated by flow arrows.

.1 Support at inlet and outlet flanges or unions.

.2 Install with bearing lubrication points accessible.

.3 Ensure that pump body does not support piping or equipment.

.1 Provide stanchions or hangers for this purpose.

.2 Refer to manufacturer's installation instructions for details.

.4 Decrease from line size, with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings.

.5 Pipe drain tapping to floor drain.

.6 Install volute venting pet cock in accessible location.

.7 Check rotation prior to start-up.

.8 Install pressure gauge test cocks.

3.3 Start-Up

.1 General:

.1 In accordance with Section 01 91 31 - Commissioning Plan, supplemented as specified herein.

.2 In accordance with manufacturer's recommendations.

3.4 Cleaning

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

.1 Remove surplus materials, excess materials, rubbish, tools, and equipment.

END OF SECTION

REFRIGERANT PIPING

1. GENERAL

1.1 Description

.1 For additional information, refer to Section 21 05 01 - Common Work Results for Mechanical and Division 1 - General Conditions of the Construction Contract.

.2 For a list of applicable codes and standards, refer to Section 21 05 01 - Common Work Results for Mechanical.

.3 The Construction Contractor shall be responsible for coordinating all aspects of this Work.

.4 Locations of equipment, ductwork, pipework, and all associated appurtenances indicated on the Drawings are approximate only. The Construction Contractor is responsible for checking and coordinating the locations of equipment, ductwork, pipework, and all associated appurtenances and shall make any necessary adjustments in positions to conform with the architectural features, other services, symmetry, clearances, and lighting arrangements.

1.2 Scope of Work

.1 The Scope of Work for this Section includes, but is not limited to, the following:

.1 Materials and procedures for the provision and installation of refrigeration pipework, valves, and fittings for HVAC systems.

1.3 Related Work

.1 This Section may not contain all materials, equipment and requirements required for the completion of this project. This Section is to be read in conjunction with the remaining Sections of Division 21, 22 and 23 and all related works.

.2 Division 1 forms an integral part of Division 21, 22 and 23.

1.4 References

.1 Except as specified herein, the latest edition of the standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

.2 In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

.3 American Society of Mechanical Engineers (ASME):

.1 ASME B16.22, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.

.2 ASME B16.24, Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves: Classes 150, 300, 600, 900, 1500 and 2500.

.3 ASME B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.

.4 ASME B31.5, Refrigeration Piping and Heat Transfer Components.

.4 American Society for Testing and Materials International (ASTM):

.1 ASTM A 307, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.

.2 ASTM B 280, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

.5 Canadian Standards Association (CSA International):

.1 CSA B52, Mechanical Refrigeration Code.

.6 Environment Canada (EC):

.1 EPS 1/RA/1, Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

.7 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

.1 Safety Data Sheets (SDS).

1.5 Action and Informational Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical and Section 01 33 00 - Submittal Procedures for submission requirements.

.2 Product Data: Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Submit copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

1.6 Closeout Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical, Section 01 33 00 - Submittal Procedures, and Section 01 78 00 - Closeout Submittals for submission requirements.

1.7 Delivery, Storage and Handling

.1 Shipping:

.1 All equipment, material and spare parts shall be shipped, stored, handled, and installed in such a manner as not to degrade quality, serviceability, or appearance. Equipment and material warranties shall not be voided by actions of the Construction Contractor.

.2 Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

.3 Pack spare parts in containers bearing labels clearly designated contents and pieces of equipment for which intended.

.4 Deliver spare parts at same time as pertaining equipment. Deliver to the City after completion of Work.

.2 Receiving:

.1 All equipment, material and spare parts shall be delivered to the Site in original packages or containers bearing the manufacturer's labels and product identification.

.2 Inspect for damage and correctness, and inventory items, upon delivery to Site.

.3 Store equipment, material and spare parts protected for the weather, humidity and temperature variations, dirt and dust or other contaminants. Store and safeguard in accordance with Manufacturer's recommendations.

1.8 Quality Assurance

.1 Performance Requirements:

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

2. PRODUCTS

2.1 Refrigerant Pipe, fittings, and Joints

.1 Type "L" hard drawn seamless copper tubing (ACR) to ASTM B88, factory cleaned in accordance with ASTM B280 and ANSI B31.5, pressurized or pre-purged with nitrogen and supplied with capped ends, and complete with factory washed and capped wrought copper soldering fittings, and solder joints made with high melting point silver brazing alloy conforming to AWS Classification BCuP-5.

2.2 Refrigerant Piping Valves and Accessories

.1 Ball Type Shut-off Valves:

.1 1/4 turn, CSA certified forged brass ball valves, each suitable for a maximum working pressure of 3445 kPa, and complete with carbon filled Teflon ball seals, two O-ring stem seals, a gasketed seal cap, a flow direction arrow cast into the body, a ball position indicator on the stem, and extended copper tube solder connections to permit soldering the valve into the line without disassembling the valve.

.2 Diaphragm Type Shut-Off Valves: Forged brass, frost-proof, Type 1 Series, CSA certified packless diaphragm type line valves, each suitable for a maximum working pressure of 3445 kPa, and each complete with an O-ring to prevent moisture from entering the diaphragm chamber, one phosphor bronze and two (2) stainless steel diaphragms, and extended copper tube solder connections.

.2 All refrigerant piping valves and accessories are to be factory cleaned, washed, and supplied with capped ends.

2.3 Refrigerant Piping Flexible Connections

.1 Phosphor bronze construction, factory cleaned, dried, and sealed flexible pipe connections with soldering ends.

3. EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Provide all required refrigerant piping. Pipe is to be type "L" hard copper, factory cleaned, capped, and marked "ACR".

.2 All elbows are to be short radius elbows to allow for the installation of specified insulation and jacketing.

.3 Refrigerant piping and direct expansion refrigeration equipment must be installed by skilled and qualified refrigeration mechanics.

.4 The exact arrangement and installation of refrigerant piping is to be reviewed with and approved by the direct expansion refrigeration equipment manufacturer both prior to and after installation of the piping and equipment.

.5 Make all refrigerant pipe solder joints using a light coat of an approved brazing flux applied to both pipe and fittings. Do not use an acid flux. During the soldering process, ensure that the pipe and fittings are kept full of nitrogen or carbon dioxide to prevent scale formation.

.6 Provide shut-off valves to isolate each piece of equipment if shut-off valves are not supplied integral with the equipment. Shut-off valves inside the building are to be ball or diaphragm type. Shut-off valves outside the building are to be diaphragm type.

.7 Provide a refrigerant charging valve for each system if such a valve is not supplied integral with equipment.

.8 Provide all refrigerant piping system accessories shown. Install in accordance with the manufacturer’s instructions. Provide all required refrigerant.

.9 Provide flexible connections at piping connections to mounted condensing units. Install in accordance with the manufacturer’s instructions.

3.3 Cleaning

.1 Remove surplus materials, excess materials, rubbish, tools, and equipment.

END OF SECTION

METAL DUCTS - LOW PRESSURE TO 500 PA

1. GENERAL

1.1 Description

.1 For additional information, refer to Section 21 05 01 - Common Work Results for Mechanical and Division 1 - General Conditions of the Construction Contract.

.2 For a list of applicable codes and standards, refer to Section 21 05 01 - Common Work Results for Mechanical.

.3 The Construction Contractor shall be responsible for coordinating all aspects of this Work.

.4 Locations of equipment, ductwork, pipework, and all associated appurtenances indicated on the Drawings are approximate only. The Construction Contractor is responsible for checking and coordinating the locations of equipment, ductwork, pipework, and all associated appurtenances and shall make any necessary adjustments in positions to conform with the architectural features, other services, symmetry, clearances, and lighting arrangements.

1.2 Scope of Work

.1 The Scope of Work for this Section includes, but is not limited to, the following:

.1 Materials and procedures for the provision and installation of low pressure duct systems.

1.3 Related Work

.1 This Section may not contain all materials, equipment and requirements required for the completion of this project. This Section is to be read in conjunction with the remaining Sections of Division 21, 22 and 23 any and all related works.

.2 Division 1 forms an integral part of Division 21, 22 and 23.

1.4 References

.1 Except as specified herein, the latest edition of the standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

.2 In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

.3 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

.4 American Society for Testing and Materials International, (ASTM):

.1 ASTM A 480/A 480M, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.

.2 ASTM A 653/A 653M, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

.1 Material Safety Data Sheets (MSDS).

.6 National Fire Protection Association (NFPA):

.1 NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.

.7 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):

.1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2nd Edition and Addendum No. 1.

.8 American Welding Society:

.1 AWS D9.1M/D9.1 - Sheet Metal Welding Code - 6th Edition.

1.5 Action and Informational Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical and Section 01 33 00 - Submittal Procedures for submission requirements.

.2 Product Data: Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Submit copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

1.6 Closeout Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical, Section 01 33 00 - Submittal Procedures, and Section 01 78 00 - Closeout Submittals for submission requirements.

1.7 Delivery, Storage and Handling

.1 Shipping:

.1 All equipment, material and spare parts shall be shipped, stored, handled, and installed in such a manner as not to degrade quality, serviceability, or appearance. Equipment and material warranties shall not be voided by actions of the Construction Contractor.

.2 Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

.3 Pack spare parts in containers bearing labels clearly designated contents and pieces of equipment for which intended.

.4 Deliver spare parts at same time as pertaining equipment. Deliver to the City after completion of Work.

.2 Receiving:

.1 All equipment, material and spare parts shall be delivered to the Site in original packages or containers bearing the manufacturer's labels and product identification.

.2 Inspect for damage and correctness, and inventory items, upon delivery to Site.

.3 Store equipment, material and spare parts protected for the weather, humidity and temperature variations, dirt and dust or other contaminants. Store and safeguard in accordance with Manufacturer's recommendations.

1.8 Quality Assurance

.1 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.

.2 Welding:

.1 Certify welding procedures, welding equipment and welders in accordance with AWS D9.1 Sheet Metal Welding Code.

2. PRODUCTS

2.1 General

.1 Classification:

.1 Duct Classification:

Pressure (Pa)	SMACNA Seal Class	Notes
1,000	A	Apply this level of sealing to ductwork running though Mechanical Chase and to Odour Control ductwork.
750	B	
500	C	

.2 Seal Classification:

.1 Class A: All transverse joints, longitudinal seams, and duct wall penetrations.

.2 Class B: All transverse joints and longitudinal seams only.

.3 Class C: transverse joints and connections made air tight with gaskets, sealant, tape or combination thereof. Longitudinal seams unsealed.

2.2 Sealant

.1 Sealant: oil resistant, waterborne, polymer type flame resistant duct sealant. Temperature range of minus 30°C to plus 93°C.

2.3 Tape

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

2.4 Firestopping

.1 Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00 - Firestopping.

.2 Firestopping material and installation must not distort duct.

2.5 Galvanized Steel

.1 Lock forming quality: to ASTM A 653/A 653M, Z90 zinc coating.

.2 Thickness, fabrication and reinforcement: to SMACNA.

.3 Joints: to SMACNA.

2.6 Stainless Steel

.1 To ASTM A 480/A 480M, Type 316.

.2 Finish: No. 2B standard mill finish.

.3 Thickness, fabrication and reinforcement: to SMACNA.

.4 Joints: to be continuous inert gas welded.

2.7 Pickling and Neutralization Paste

.1 Pickling paste:

.1 For cleaning and passivating welding joints and heat affected zone.

.2 Standard of acceptance: Sandvik Formula Green.

.2 Neutralization Paste:

.1 For use on steel surfaces to neutralize and inhibit pickling paste after use.

.2 Standard of acceptance: Sandvik Neutralization Paste.

2.8 Hangers and Supports

.1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.

.1 Maximum size duct supported by strap hanger: 500.

.2 Hanger configuration: to SMACNA.

.3 Hangers: steel angle with steel rods to following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

.4 Upper hanger attachments:

.1 For concrete: manufactured concrete inserts.

.2 For steel joist: manufactured joist clamp steel plate washer.

.3 For steel beams: manufactured beam clamps.

.5 All components to be stainless steel when used with stainless steel ductwork. Adjust sizing and gauges as required to account for weight differences per SMACNA and manufacturers recommendations.

3. EXECUTION

3.1 General

.1 Do work in accordance with NFPA 90A and SMACNA.

.2 Do not break continuity of insulation vapour barrier with hangers or rods.

.3 Insulate strap hangers 100 mm beyond insulated duct.

.4 Support risers in accordance with SMACNA.

.5 Install breakaway joints in ductwork on sides of fire separation.

.6 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

3.2 Hangers

.1 Strap hangers: install in accordance with SMACNA.

.2 Angle hangers: complete with locking nuts and washers.

.3 Hanger spacing: in accordance with SMACNA.

3.3 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 coat of sealant to manufacturers recommendations.

3.4 Ductwork

.1 All ductwork to be galvanized except as follows:

.1 Provide stainless steel ductwork where shown on drawings.

.2 Areas where stainless steel ductwork is used, all associated accessories shall also be stainless steel including but not limited to hangers, supports, rods, clamps, dampers, doors and miscellaneous metals.

.3 All welded stainless steel joints shall be pickled and neutralized on site, in accordance with the product manufacturer’s recommendations.

3.5 Cleaning

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

AIR DUCT ACCESSORIES

1. GENERAL

1.1 Description

.1 For additional information, refer to Section 21 05 01 - Common Work Results for Mechanical and Division 1 - General Conditions of the Construction Contract.

.2 For a list of applicable codes and standards, refer to Section 21 05 01 - Common Work Results for Mechanical.

.3 The Construction Contractor shall be responsible for coordinating all aspects of this Work.

.4 Locations of equipment, ductwork, pipework, and all associated appurtenances indicated on the Drawings are approximate only. The Construction Contractor is responsible for checking and coordinating the locations of equipment, ductwork, pipework, and all associated appurtenances and shall make any necessary adjustments in positions to conform with the architectural features, other services, symmetry, clearances, and lighting arrangements.

1.2 Scope of Work

.1 The Scope of Work for this Section includes, but is not limited to, the following:

.1 Materials and procedures for the provision and installation of air duct accessories for HVAC systems.

1.3 Related Work

.1 This Section may not contain all materials, equipment and requirements required for the completion of this project. This Section is to be read in conjunction with the remaining Sections of Division 21, 22 and 23 and all related works.

.2 Division 1 forms an integral part of Division 21, 22 and 23.

1.4 References

.1 Except as specified herein, the latest edition of the standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

.2 In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

.1 Safety Data Sheets (SDS).

.4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):

.1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

1.5 Action and Informational Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical and Section 01 33 00 - Submittal Procedures for submission requirements.

.2 Product Data: Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish, and limitations.

.3 Submit copies of WHMIS SDS - Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

1.6 Closeout Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical, Section 01 33 00 - Submittal Procedures, and Section 01 78 00 - Closeout Submittals for submission requirements.

1.7 Delivery, Storage and Handling

.1 Shipping:

.1 All equipment, material and spare parts shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability, or appearance. Equipment and material warranties shall not be voided by actions of the Construction Contractor.

.2 Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

.3 Pack spare parts in containers bearing labels clearly designated contents and pieces of equipment for which intended.

.4 Deliver spare parts at same time as pertaining equipment. Deliver to the City after completion of Work.

.2 Receiving:

.1 All equipment, material and spare parts shall be delivered to the Site in original packages or containers bearing the manufacturer's labels and product identification.

.2 Inspect for damage and correctness, and inventory items, upon delivery to Site.

.3 Store equipment, material and spare parts protected for the weather, humidity and temperature variations, dirt and dust or other contaminants. Store and safeguard in accordance with Manufacturer's recommendations.

1.8 Quality Assurance

.1 Performance Requirements:

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

2. PRODUCTS

2.1 General

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

2.2 Flexible Connections

.1 Frame:

.1 Sheet metal frame, sheet metal to match ductwork material, one sheet metal thickness heavier than ductwork with fabric clenched by means of double locked seams.

.2 Material:

.1 Fire resistant, self-extinguishing, neoprene coated glass fabric, temperature rated for use at minus 40°C to 90°C, density of 1.3 kg/m².

2.3 Duct Access Door

.1 Uninsulated Ducts:

.1 Sandwich construction of same material as duct, one sheet metal thickness heavier than duct, minimum 0.6 mm thick complete with sheet metal angle frame.

.2 Insulated Ducts:

.1 Sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.

.3 Gaskets:

.1 Neoprene.

.4 Hardware:

.1 Provide complete with safety chain.

2.4 Turning Vanes

.1 Factory or shop fabricated double thickness with trailing edge, to recommendations of SMACNA.

3. EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Flexible Connections:

.1 Install in following locations:

.1 Inlets and outlets to supply air units and fans.

.2 Inlets and outlets of exhaust and return air fans.

.3 As indicated.

.2 Length of connection: 100 mm.

.3 Minimum distance between metal parts when system in operation: 75 mm.

.4 Install in accordance with recommendations of SMACNA.

.5 When fan is running:

.1 Ducting on sides of flexible connection to be in alignment.

.2 Ensure slack material in flexible connection.

.2 Access Doors and Viewing Panels:

.1 Size:

.1 Minimum 450 mm x 350 mm or 50 mm smaller than duct dimension for cleaning and inspection at positions as stated herein.

.2 Locations:

.1 Fire and smoke dampers.

.2 Control dampers.

.3 Devices requiring maintenance.

.4 Required by code.

.5 Reheat coils.

.6 Elsewhere as indicated.

.3 Turning Vanes:

.1 Install in accordance with recommendations of SMACNA and as indicated.

3.3 Cleaning

.1 Remove surplus materials, excess materials, rubbish, tools, and equipment.

END OF SECTION

DAMPERS - BALANCING

1. GENERAL

1.1 Description

.1 For additional information, refer to Section 21 05 01 - Common Work Results for Mechanical and Division 1 - General Conditions of the Construction Contract.

.2 For a list of applicable codes and standards, refer to Section 21 05 01 - Common Work Results for Mechanical.

.3 The Construction Contractor shall be responsible for coordinating all aspects of this Work.

.4 Locations of equipment, ductwork, pipework, and all associated appurtenances indicated on the Drawings are approximate only. The Construction Contractor is responsible for checking and coordinating the locations of equipment, ductwork, pipework, and all associated appurtenances and shall make any necessary adjustments in positions to conform with the architectural features, other services, symmetry, clearances, and lighting arrangements.

1.2 Scope of Work

.1 The Scope of Work for this Section includes, but is not limited to, the following:

.1 Materials and procedures for the provision and installation of balancing dampers for HVAC systems.

1.3 Related Work

.1 This Section may not contain all materials, equipment and requirements required for the completion of this project. This Section is to be read in conjunction with the remaining Sections of Division 21, 22 and 23 and all related works.

.2 Division 1 forms an integral part of Division 21, 22 and 23.

1.4 References

.1 Except as specified herein, the latest edition of the standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

.2 In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

.3 Sheet Metal and Air Conditioning National Association (SMACNA):

.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

.1 Safety Data Sheets (SDS).

1.5 Action and Informational Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical and Section 01 33 00 - Submittal Procedures for submission requirements.

.2 Product Data: Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Submit copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

1.6 Closeout Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical, Section 01 33 00 - Submittal Procedures, and Section 01 78 00 - Closeout Submittals for submission requirements.

1.7 Delivery, Storage and Handling

.1 Shipping:

.1 All equipment, material and spare parts shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability, or appearance. Equipment and material warranties shall not be voided by actions of the Construction Contractor.

.2 Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

.3 Pack spare parts in containers bearing labels clearly designated contents and pieces of equipment for which intended.

.4 Deliver spare parts at same time as pertaining equipment. Deliver to the City after completion of Work.

.2 Receiving:

.1 All equipment, material and spare parts shall be delivered to the Site in original packages or containers bearing the manufacturer's labels and product identification.

.2 Inspect for damage and correctness, and inventory items, upon delivery to Site.

.3 Store equipment, material and spare parts protected for the weather, humidity and temperature variations, dirt and dust or other contaminants. Store and safeguard in accordance with manufacturer's recommendations.

1.8 Quality Assurance

.1 Performance Requirements:

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

2. PRODUCTS

2.1 General

.1 Manufacture to SMACNA standards.

2.2 Single Bladed Dampers

.1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.

.2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm.

.3 Locking quadrant with shaft extension to accommodate insulation thickness.

.4 Inside and outside nylon or bronze end bearings.

.5 Channel frame of same material as adjacent duct, complete with angle stop.

2.3 Multi-Bladed Dampers

.1 Factory manufactured of material compatible with duct.

.2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.

.3 Maximum blade height: 100 mm.

.4 Bearings: pin in bronze bushings or self-lubricating nylon.

.5 Linkage: shaft extension with locking quadrant.

.6 Channel frame of same material as adjacent duct, complete with angle stop.

3. EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.2 Locate balancing dampers in each branch duct, for supply, return and exhaust systems.

.3 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.

.4 Dampers: vibration free.

.5 Ensure damper operators are observable and accessible.

3.3 Cleaning

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

DAMPERS - CONTROL

1. GENERAL

1.1 Description

.1 For additional information, refer to Section 21 05 01 - Common Work Results for Mechanical and Division 1 - General Conditions of the Construction Contract.

.2 For a list of applicable codes and standards, refer to Section 21 05 01 - Common Work Results for Mechanical.

.3 The Construction Contractor shall be responsible for coordinating all aspects of this Work.

.4 Locations of equipment, ductwork, pipework, and all associated appurtenances indicated on the Drawings are approximate only. The Construction Contractor is responsible for checking and coordinating the locations of equipment, ductwork, pipework, and all associated appurtenances and shall make any necessary adjustments in positions to conform to the architectural features, other services, symmetry, clearances, and lighting arrangements.

1.2 Scope of Work

.1 The Scope of Work for this Section includes, but is not limited to, the following:

.1 Materials and procedures for the provision and installation of control and barometric dampers and associated actuators for HVAC systems.

1.3 Related Work

.1 This Section may not contain all materials, equipment and requirements required for the completion of this project. This Section is to be read in conjunction with the remaining Sections of Division 21, 22 and 23 any and all related works.

.2 Division 1 forms an integral part of Division 21, 22 and 23.

1.4 References

.1 Except as specified herein, the latest edition of the standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

.2 In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

.3 American Society for Testing and Materials International (ASTM):

.1 ASTM A 653/A 653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

.1 Safety Data Sheets (SDS).

1.5 Action and Informational Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical and Section 01 33 00 - Submittal Procedures for submission requirements.

.2 Product Data: Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Submit copies of WHMIS SDS - Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

1.6 Closeout Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical, Section 01 33 00 - Submittal Procedures, and Section 01 78 00 - Closeout Submittals for submission requirements.

1.7 Delivery, Storage and Handling

.1 Shipping:

.1 All equipment, material and spare parts shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability, or appearance. Equipment and material warranties shall not be voided by actions of the Construction Contractor.

.2 Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

.3 Pack spare parts in containers bearing labels clearly designated contents and pieces of equipment for which intended.

.4 Deliver spare parts at same time as pertaining equipment. Deliver to the City after completion of Work.

.2 Receiving:

.1 All equipment, material and spare parts shall be delivered to the Site in original packages or containers bearing the manufacturer's labels and product identification.

.2 Inspect for damage and correctness, and inventory items, upon delivery to Site.

.3 Store equipment, material and spare parts protected for the weather, humidity and temperature variations, dirt and dust or other contaminants. Store and safeguard in accordance with Manufacturer's recommendations.

1.8 Quality Assurance

.1 Performance Requirements:

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

2. PRODUCTS

2.1 Outdoor Air Control Dampers

.1 Frame:

.1 Extruded aluminum (6063-T5), minimum thickness 2 mm, frame depth minimum 100 mm insulated with polystyrofoam on four sides, thermally broken frame with polyurethane resin pockets.

.2 Blades:

.1 Extruded aluminum (6063-T5) profiles internal insulated with expanded polyurethane foam, thermally broken. Blade shall have an insulating factor of 0.436 w/m²K, frame and blade seal extruded silicone secured in an integral slot within the extrusions, opposed blade configuration.

.3 Bearings:

.1 Celcon inner bearing fixed to 11 mm aluminum hexagon blade pin, rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal or metal-to-plastic contact.

.4 Linkage:

.1 Hardware shall be installed in the frame side and constructed of aluminum and corrosion-resistant, zinc-plated steel, complete with cup-point trunnion screws for a slip-proof grip. Dampers are to be designed for operation in temperatures ranging between minus 40°C and 85°C.

.5 Leakage:

.1 Low Leakage: 8.6 L/s/m^2 at 250 Pa pressure difference for a 1220 mm x 1220 mm damper.

.2 Standard Leakage: 25 L/s/m^2 at 250 Pa pressure difference for a 1220 mm x 1220 mm damper.

2.2 General Control Dampers

.1 Frame:

.1 Extruded aluminum (6063-T5), minimum thickness 2 mm, frame depth minimum 100 mm with mounting flanges on both sides of the frame.

.2 Blades:

.1 Extruded aluminum (6063T5) air-foil profiles, frame and blade seal extruded silicone secured in an integral slot within the extrusions, opposed blade configuration.

.3 Bearings:

.1 Celcon inner bearing fixed to 11 mm aluminum hexagon blade pin, rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal or metal-to-plastic contact.

.4 Linkage:

.1 Hardware shall be installed in the frame side and constructed of aluminum and corrosion-resistant, zinc-plated steel, complete with cup-point trunnion screws for a slip-proof grip. Dampers are to be designed for operation in temperatures ranging between minus 40°C and 100°C.

.5 Leakage:

.1 Dampers shall be rated Leakage Class 1A at 0.25 kPa static pressure differential. Standard air leakage data shall be certified under the AMCA Certified Ratings Program.

2.3 Electronic Damper Actuators

.1 Manufacturers:

.1 Schischek by Rotork Controls

.2 Belimo

.3 Johnson Controls

.4 Siemens

.5 Or approved equal in accordance with B7.

.2 CSA or cUL approved.

.3 Operating voltage: 120 VAC.

.4 Suitable for operating temperature range encountered by application with minimum ambient operating temperature range of -40°C to +50°C.

.5 On-Off:

.1 Spring return, 150 seconds maximum driving time for 95 degree operation and 35 seconds maximum spring return time, with visual position indicator and manual override.

.2 Provide two (2) auxiliary end-switch contacts, one (1) for fully open and one (1`) for fully close, for each on/off damper.

.3 Position feedback: Equip two-position actuators with limits switches or other positive means of a position indication signal for remote monitoring of open and close position.

.6 Modulating:

.1 Spring return, 150 seconds maximum driving time for 95 degree operation and 35 seconds maximum spring return time, with visual position indicator and manual override.

.2 Provide a 4-20 mA position signal for each modulating damper.

.3 Provide a 4-20 mA position feedback signal for each modulating damper.

.7 Provide sufficient damper motors to achieve unrestricted movement, with a minimum of one damper operator per damper section.

.8 Provide the following rated actuator enclosures:

Location	Area Classification	Rating
Indoor	Non-Hazardous	N/A
Outdoor	Non-Hazardous	NEMA 4
Indoor	Hazardous	NEMA 7
Outdoor	Hazardous	NEMA 8

2.4 Barometric Dampers

.1 Extruded aluminum, 6063-T5, frame 63.5 mm deep, with a minimum metal thickness of 1.52 mm.

.2 Blades shall be extruded aluminum, 6063-T5, profiles with a minimum metal thickness of 1.52 mm. Provide aluminum, 6063-T6, counterbalance weights mounted to each blade. Counterbalance weights shall be full adjustable. Damper shall have extruded silicone blade and side seals secured in integral slots within the aluminum extrusions. Blades and frame shall be mechanically fastened.

.3 Bearings shall be 12.7 mm aluminum pivot points rotating on Celcon bearings. Linkage system shall be of hard alloy aluminum, 6065-T6, fastened to aluminum pivot rods and doubly secured within the channel running along the top of blade.

.4 Maximum blade length of 750 mm.

.5 Backdraft damper suitable for 10 m/s face velocity.

3. EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Install where indicated.

.2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.

.3 Seal multiple damper modules with silicon sealant.

.4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.

.5 Ensure dampers are observable and accessible.

3.3 Cleaning

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

DAMPERS - FIRE AND SMOKE

1. GENERAL

1.1 Description

.1 For additional information, refer to Section 21 05 01 - Common Work Results for Mechanical and Division 1 - General Conditions of the Construction Contract.

.2 For a list of applicable codes and standards, refer to Section 21 05 01 - Common Work Results for Mechanical.

.3 The Construction Contractor shall be responsible for coordinating all aspects of this Work.

.4 Locations of equipment, ductwork, pipework, and all associated appurtenances indicated on the Drawings are approximate only. The Construction Contractor is responsible for checking and coordinating the locations of equipment, ductwork, pipework, and all associated appurtenances and shall make any necessary adjustments in positions to conform with the architectural features, other services, symmetry, clearances, and lighting arrangements.

1.2 Scope of Work

.1 The Scope of Work for this Section includes, but is not limited to, the following:

.1 Materials and procedures for the provision and installation of fire dampers for HVAC systems.

1.3 Related Work

.1 This Section may not contain all materials, equipment and requirements required for the completion of this project. This Section is to be read in conjunction with the remaining Sections of Division 21, 22 and 23 and all related works.

.2 Division 1 forms an integral part of Division 21, 22 and 23.

1.4 References

.1 Except as specified herein, the latest edition of the standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

.2 In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

.3 American National Standards Institute/National Fire Protection Association (ANSI/NFPA):

.1 ANSI/NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

.1 Safety Data Sheets (SDS).

.5 Underwriters Laboratories:

.1 UL-555, UL Standard for Safety Fire Dampers.

.6 Underwriters Laboratories of Canada (ULC):

.1 ULC-S505, Standard for Fusible Links for Fire Protection Service.

1.5 Action and Informational Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical and Section 01 33 00 - Submittal Procedures for submission requirements.

.2 Product Data: Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Submit copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

1.6 Closeout Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical, Section 01 33 00 - Submittal Procedures, and Section 01 78 00 - Closeout Submittals for submission requirements.

1.7 Delivery, Storage and Handling

.1 Shipping:

.1 All equipment, material and spare parts shall be shipped, stored, handled, and installed in such a manner as not to degrade quality, serviceability, or appearance. Equipment and material warranties shall not be voided by actions of the Construction Contractor.

.2 Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

.3 Pack spare parts in containers bearing labels clearly designated contents and pieces of equipment for which intended.

.4 Deliver spare parts at same time as pertaining equipment. Deliver to the City after completion of Work.

.2 Receiving:

.1 All equipment, material and spare parts shall be delivered to the Site in original packages or containers bearing the manufacturer's labels and product identification.

.2 Inspect for damage and correctness, and inventory items, upon delivery to Site.

.3 Store equipment, material and spare parts protected for the weather, humidity and temperature variations, dirt and dust or other contaminants. Store and safeguard in accordance with Manufacturer's recommendations.

1.8 Quality Assurance

.1 Performance Requirements:

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

2. PRODUCTS

2.1 Fire Damper (Dynamic)

.1 Fire dampers:

.1 Listed and bearing label of ULC, meeting requirements of ANSI/NFPA 90A and Authorities Having Jurisdiction.

.2 Fire tested in accordance with UL-555.

.3 Provide 40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced. Equip fire dampers with steel sleeve or frame installed disruption ductwork or impair damper operation. Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.

.2 For Galvanised Steel Ductwork Systems:

.1 Fire Resistance:

.1 Dampers shall have a UL 555 fire resistance rating of 1½ hours.

.2 Fire Closure Temperature:

.1 Each fire damper shall be equipped with a factory installed heat responsive device (fusible link) rated to close the damper when temperature at the damper reaches 71ºC.

.3 Differential Pressure:

.1 Dampers shall have a minimum UL 555 differential pressure rating of 996 Pa.

.4 Velocity:

.1 Dampers shall have a minimum UL 555 velocity rating of 10 m/sec.

.5 Dynamic Fire Damper (DFD) Construction:

.1 Dampers will be of Type 'C' with connections to suit duct size and shape. The frame shall be of galvanized steel of thickness required by manufacturer's UL listing. The blades shall be of galvanised steel arranged in a curtain style. The damper shall be supplied complete with all sleeves and retaining angles required to complete the installation as required by the manufacturer's UL listing.

.3 For Stainless Steel Ductwork Systems:

.1 Dampers shall be as above with all parts in the airstream manufactured from stainless steel.

3. EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Install in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing.

.2 Maintain integrity of fire separation.

.3 After completion and prior to concealment obtain approvals of complete installation from Authority Having Jurisdiction.

.4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.

.5 Co-ordinate with installer of fire stopping.

.6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.

.7 Install break-away joints of approved design on each side of fire separation.

.8 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition of floor slab depth or thickness.

.9 Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed.

3.3 Cleaning

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

FANS AND ACCESSORIES

1. GENERAL

1.1 Description

.1 For additional information, refer to Section 21 05 01 - Common Work Results for Mechanical and Division 1 - General Conditions of the Construction Contract.

.2 For a list of applicable codes and standards, refer to Section 21 05 01 - Common Work Results for Mechanical.

.3 The Construction Contractor shall be responsible for coordinating all aspects of this Work.

.4 Locations of equipment, ductwork, pipework, and all associated appurtenances indicated on the Drawings are approximate only. The Construction Contractor is responsible for checking and coordinating the locations of equipment, ductwork, pipework, and all associated appurtenances and shall make any necessary adjustments in positions to conform with the architectural features, other services, symmetry and lighting arrangements.

1.2 Scope of Work

.1 The Scope of Work for this Section includes, but is not limited to, the following:

.1 Materials and procedures for the provision and installation of supply and exhaust fans.

1.3 Related Work

.1 This Section may not contain all materials, equipment and requirements required for the completion of this project. This Section is to be read in conjunction with the remaining Sections of Division 21, 22 and 23 any and all related works.

.2 Division 1 forms an integral part of Division 21, 22 and 23.

1.4 References

.1 Except as specified herein, the latest edition of the standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

.2 In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

.3 Air Conditioning and Mechanical Contractors (AMCA):

.1 AMCA Publication 99, Standards Handbook.

.2 AMCA 300, Reverberant Room Method for Sound Testing of Fans.

.3 AMCA 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.4 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME):

.1 ANSI/AMCA 210, Laboratory Methods of Testing Fans for Aerodynamic.

.5 Canadian General Standards Board (CGSB):

.1 CAN/CGSB 1.181, Ready-Mixed Organic Zinc-Rich Coating.

.6 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

.1 Material Safety Data Sheets (MSDS).

1.5 Action and Informational Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical and Section 01 33 00 - Submittal Procedures for submission requirements.

.2 Product Data: Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Submit copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

1.6 Closeout Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical, Section 01 33 00 - Submittal Procedures, and Section 01 78 00 - Closeout Submittals for submission requirements.

1.7 Delivery, Storage and Handling

.1 Shipping:

.1 All equipment, material and spare parts shall be shipped, stored, handled, and installed in such a manner as not to degrade quality, serviceability, or appearance. Equipment and material warranties shall not be voided by actions of the Construction Contractor.

.2 Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

.3 Pack spare parts in containers bearing labels clearly designated contents and pieces of equipment for which intended.

.4 Deliver spare parts at same time as pertaining equipment. Deliver to the City after completion of Work.

.2 Receiving:

.1 All equipment, material and spare parts shall be delivered to the Site in original packages or containers bearing the manufacturer's labels and product identification.

.2 Inspect for damage and correctness, and inventory items, upon delivery to Site.

.3 Store equipment, material and spare parts protected for the weather, humidity and temperature variations, dirt and dust or other contaminants. Store and safeguard in accordance with Manufacturer's recommendations.

1.8 Quality Assurance

.1 Performance Requirements:

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

2. PRODUCTS

2.1 Belt Drive Sidewall Upblast Centrifugal Exhaust Fans

.1 General Description:

.1 Discharge air up and away from the mounting surface.

.2 Upblast fan shall be for wall mounted applications.

.3 Maximum continuous operating temperature is 204.4°C.

.4 Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number.

.2 Fan Housing and Outlet:

.1 Constructed of heavy gauge aluminum includes exterior housing, curb cap, windband, and motor compartment housing.

.2 Housing shall have a rigid internal support structure.

.3 Windband to be one piece spun aluminum construction and maintain original material thickness throughout the housing.

.4 Windband to include an integral rolled bead for strength.

.5 Curb cap base to be fully welded to windband to ensure a leak proof construction. Tack welding, bolting, and caulking are not acceptable.

.6 Curb cap to have integral deep spun inlet venturi and pre-punched mounting holes to ensure correct attachment to curb.

.7 Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators.

.8 Breather tube shall be 10 square inches in size for fresh air motor cooling, and designed to allow wiring to be run through it.

.3 Vibration Isolation:

.1 Double studded or pedestal style true isolators.

.2 No metal to metal contact.

.4 Wheel:

.1 Material type: aluminum.

.2 Non-overloading, backward inclined centrifugal.

.3 Statically and dynamically balanced in accordance to AMCA Standard 204-05.

.4 The wheel cone and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency.

.5 Fan Motor and Drive:

.1 Motors:

.1 Motor enclosures: Open drip-proof.

.2 Motors are heavy duty ball bearing type to match with the fan load and furnished at the specific voltage and phase.

.3 Mounted on vibration isolators, out of the airstream.

.4 For motor cooling there shall be fresh air drawn into the motor compartment through an area free of discharge contaminants.

.5 Accessible for maintenance.

.2 Shafts and Bearings:

.1 Fan shaft shall be ground and polished solid steel with an anti corrosive coating.

.2 Permanently sealed bearings or pillow block ball bearings.

.3 Bearing shall be selected for a minimum L10 life in excess of 100,000 hours (equivalent to L50 average life of 500,000 hours), at maximum cataloged operating speed.

.4 Bearings are 100% factory tested.

.5 Fan Shaft first critical speed is at least 25% over maximum operating speed.

.3 Belts, pulleys, and keys oversized for a minimum of 150% of driven horsepower:

.1 Belt: Static free and oil resistant.

.2 Fully machined cast iron pulleys, keyed and securely attached to the wheel and motor shafts.

.3 Motor pulley adjustable for final system balancing.

.4 Readily accessible for maintenance.

.6 Disconnect Switches:

.1 NEMA rated: 3R.

.2 Positive electrical shut-off.

.3 Wired from fan motor to junction box installed within motor compartment.

.7 Options/Accessories:

.1 Finishes: thermo-setting polyester urethane.

.2 Wall Collar:

.1 Galvanized steel with heavy gauge mounting flanges and pre-punched mounting holes.

.3 Screen: Birdscreen.

.4 Dampers:

.1 Type: Gravity.

.2 Prevents outside air from entering back into the building when fan is off.

.3 Balanced for minimal resistance to flow.

.4 Galvanized frames with pre-punched mounting holes.

3. EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Cleaning

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

DIFFUSERS, REGISTERS, AND GRILLES

1. GENERAL

1.1 Description

.1 For additional information, refer to Section 21 05 01 - Common Work Results for Mechanical and Division 1 - General Conditions of the Construction Contract.

.2 For a list of applicable codes and standards, refer to Section 21 05 01 - Common Work Results for Mechanical.

.3 The Construction Contractor shall be responsible for coordinating all aspects of this Work.

.4 Locations of equipment, ductwork, pipework, and all associated appurtenances indicated on the Drawings are approximate only. The Construction Contractor is responsible for checking and coordinating the locations of equipment, ductwork, pipework, and all associated appurtenances and shall make any necessary adjustments in positions to conform with the architectural features, other services, symmetry, clearances, and lighting arrangements.

1.2 Scope of Work

.1 The Scope of Work for this Section includes, but is not limited to, the following:

.1 Materials and procedures for the provision and installation of diffusers, registers, grilles, and hoods.

1.3 Related Work

.1 This Section may not contain all materials, equipment and requirements required for the completion of this project. This Section is to be read in conjunction with the remaining Sections of Division 21, 22 and 23 and all related works.

.2 Division 1 forms an integral part of Division 21, 22 and 23.

1.4 References

.1 Except as specified herein, the latest edition of the standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

.2 In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

1.5 Action and Informational Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical and Section 01 33 00 - Submittal Procedures for submission requirements.

.2 Product Data: Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Submit copies of WHMIS SDS - Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

1.6 Closeout Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical, Section 01 33 00 - Submittal Procedures, and Section 01 78 00 - Closeout Submittals" for submission requirements.

1.7 Delivery, Storage and Handling

.1 Shipping:

.1 All equipment, material and spare parts shall be shipped, stored, handled, and installed in such a manner as not to degrade quality, serviceability, or appearance. Equipment and material warranties shall not be voided by actions of the Construction Contractor.

.2 Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

.3 Pack spare parts in containers bearing labels clearly designated contents and pieces of equipment for which intended.

.4 Deliver spare parts at same time as pertaining equipment. Deliver to the City after completion of Work.

.2 Receiving:

.1 All equipment, material and spare parts shall be delivered to the Site in original packages or containers bearing the manufacturer's labels and product identification.

.2 Inspect for damage and correctness, and inventory items, upon delivery to Site.

.3 Store equipment, material and spare parts protected for the weather, humidity and temperature variations, dirt and dust or other contaminants. Store and safeguard in accordance with Manufacturer's recommendations.

1.8 Quality Assurance

.1 Performance Requirements:

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

2. PRODUCTS

2.1 General

.1 Provide supply outlets with sponge rubber seal around the edge.

.2 Provide baffles to direct air away from walls, columns or other obstructions within the radius of diffuser operation.

.3 Provide plaster frame for diffusers located in plaster surfaces.

.4 Refer to Schedule for specifications of air outlets.

2.2 Grilles

.1 General:

.1 Grilles supplied from one manufacturer.

.2 Supply Register:

.1 Double deflection grilles with fully adjustable 32 mm (1-1/4 inch) deep streamlined deflection blades spaced 38 mm (1-1/2 inches) on center.

.2 The grille blades, border, and mullions material shall be heavy extruded aluminum construction.

.3 The individually adjustable blades shall index and lock into position at 0, 15, 30, and 45 degrees deflection in either direction. The grille indexing device shall be stainless steel construction.

.4 The grille shall be supplied with a coated steel opposed blade damper, operable from the grille face.

.3 Exhaust Register:

.1 Grilles shall be 45 degree deflection fixed louver type, with 19 mm (¾ inch) on center blade spacing.

.2 The blades and border shall be heavy duty extruded aluminum construction.

.3 The grille shall be supplied with a coated steel opposed blade damper.

3. EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Install with flat head, stainless steel screws in countersunk holes where fastenings are visible.

.2 Paint ductwork visible behind diffusers and grilles matte black.

3.3 Cleaning

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

LOUVERS, INTAKES, AND VENTS

1.1 Description

.1 For additional information, refer to Section 21 05 01 - Common Work Results for Mechanical and Division 1 - General Conditions of the Construction Contract.

.2 For a list of applicable codes and standards, refer to Section 21 05 01 - Common Work Results for Mechanical.

.3 The Construction Contractor shall be responsible for coordinating all aspects of this Work.

.4 Locations of equipment, ductwork, pipework, and all associated appurtenances indicated on the Drawings are approximate only. The Construction Contractor is responsible for checking and coordinating the locations of equipment, ductwork, pipework, and all associated appurtenances and shall make any necessary adjustments in positions to conform with the architectural features, other services, symmetry, clearances, and lighting arrangements.

1.2 Scope of Work

.1 The Scope of Work for this Section includes, but is not limited to, the following:

.1 Materials and procedures for the provision and installation of air intake and exhaust louvres.

1.3 Related Work

.1 This Section may not contain all materials, equipment and requirements required for the completion of this project. This Section is to be read in conjunction with the remaining Sections of Division 21, 22 and 23 and all related works.

.2 Division 1 forms an integral part of Division 21, 22 and 23.

1.4 References

.1 Except as specified herein, the latest edition of the standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

.2 In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

.3 American Society for Testing and Materials International (ASTM):

.1 ASTM E 90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

.4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

1.5 Action and Informational Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical and Section 01 33 00 - Submittal Procedures for submission requirements.

.2 Product Data: Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish, and limitations.

.3 Submit copies of WHMIS SDS - Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

1.6 Closeout Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical, Section 01 33 00 - Submittal Procedures, and Section 01 78 00 - Closeout Submittals for submission requirements.

1.7 Delivery, Storage and Handling

.1 Shipping:

.1 All equipment, material and spare parts shall be shipped, stored, handled, and installed in such a manner as not to degrade quality, serviceability, or appearance. Equipment and material warranties shall not be voided by actions of the Construction Contractor.

.2 Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

.3 Pack spare parts in containers bearing labels clearly designated contents and pieces of equipment for which intended.

.4 Deliver spare parts at same time as pertaining equipment. Deliver to the City after completion of Work.

.2 Receiving:

.1 All equipment, material and spare parts shall be delivered to the Site in original packages or containers bearing the manufacturer's labels and product identification.

.2 Inspect for damage and correctness, and inventory items, upon delivery to Site.

.3 Store equipment, material and spare parts protected for the weather, humidity and temperature variations, dirt and dust or other contaminants. Store and safeguard in accordance with Manufacturer's recommendations.

1.8 Quality Assurance

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

2. PRODUCTS

2.1 Louvers

.1 Drainable Louver of size and shape indicated on the plans and/or as described in schedules.

.2 Louvers shall be constructed entirely of extruded aluminum, alloy 6063-T5. Blades and frames shall be minimum 2.06 mm (0.081 inch) wall thickness.

.3 Louver assemblies shall be 152.4 mm (6 inch) deep with 35-degree stationary drainable blades.

.4 Louver performance shall be based on tests and procedures in accordance with AMCA publication 511 and comply with the requirements of the AMCA Certified Rating Program.

.5 Louvers shall be designed to withstand a 122 kg/sm (25 psf), 160 kM/hr (100 mph) wind equivalent wind load.

.6 Each louver shall be fitted with interior mounted 12.7 mm (1/2 inch) mesh x 1.60 mm (0.063 inch) diameter aluminum bird screen.

.7 Louvers shall be factory primed and finished-after-assembly with a Duranar coating. Colour to be confirmed with architect.

.8 Standard of Acceptance: EH PRICE Model DE635 Drainable Louver.

3. EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 In accordance with manufacturer's and SMACNA recommendations.

.2 Reinforce and brace as required by manufacturer.

.3 Anchor securely into opening. Seal with caulking to ensure weather tightness.

3.3 Cleaning

.1 Remove surplus materials, excess materials, rubbish, tools, and equipment.

END OF SECTION

HEAT EXCHANGERS FOR HVAC

1. GENERAL

1.1 Scope

.1 Plate and frame type heat exchanger.

.2 Piping connections.

.3 Steel supports.

1.2 Reference Standards

.1 American Society of Mechanical Engineers (ASME):

.1 ASME Boiler and Pressure Vessel Code, 2010.

.2 CSA Group (CSA):

.1 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.

1.3 Quality Assurance

.1 Design and construction shall meet requirements of ASME code for unfired pressure vessels and provincial codes.

1.4 Action and Informational Submittals

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for heat exchangers and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Shop Drawings shall include dimensions, locations and size of tappings, and performance data to match specification.

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

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

1.5 Closeout Submittals

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

.2 Operation and Maintenance Data: submit operation and maintenance data for heat exchangers for incorporation into manual.

1.6 Maintenance Material Submittals

.1 Extra Stock Materials:

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

1.7 Delivery, Storage and Handling

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

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

.3 Storage and Handling Requirements:

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

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

.3 Replace defective or damaged materials with new.

2. PRODUCTS

2.1 General

.1 Units shall be suitable for 1034 kPa working pressure and 150°C working temperatures.

.2 Prime coat exterior of units.

2.2 Plate and Frame Type Heat Exchangers

.1 Frame:

.1 The frame plate and pressure plate shall be fabricated from carbon steel to SA 516 grade 70 and be of sufficient thickness to meet the ASME design pressure. Stiffeners or support brackets are not permitted. Frame components shall have an epoxy paint finish. The frame design shall allow the thermal plates to be supported by the carry bar, top bar. The guide bar, bottom bar, shall only help properly align the plates. A roller assembly from the carry bar shall support the pressure plate for units taller than 50". Tightening bolts shall be zinc plated carbon steel SA193 B7. Provide aluminum or stainless steel OSHA splash shield.

.2 Connections:

.1 100 mm or greater: Alloy lined studded ports to mate with raised face or flat faced ANSI flanges.

.2 50 mm or less: Carbon steel female tapped NPT or male NPT connections if an alloy material is required.

.3 65 mm or 75 mm: Either studded ports or NPT as describe above.

.3 Plates:

.1 Plates shall be constructed of 316 L Stainless Steel and pressed in a one step stamping process. Plates shall use an integral rolled edge hanging system to provide a rigid hanger device between the plate and carry bar and guide bar. Welded on hanging brackets or stiffeners are not acceptable. Plates shall be permanently marked to indicate plate material and thickness.

.4 Gaskets:

.1 The gaskets shall be manufactured from nitrile butadiene rubber and be of a one-piece construction with a double gasket barrier at the port region. The area isolated by the double gasket shall be vented to the atmosphere, so that a gasket failure is detected by leakage to the exterior prior to any possible cross contamination.

.2 Gaskets are to be “mechanically fixed”. Glued gaskets are not acceptable.

.5 Acceptable product:

.1 Bell & Gossett AP20.

.2 Or approved equivalent.

3. EXECUTION

3.1 Examination

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

.1 Visually inspect substrate in presence of Contract Administrator.

.2 Inform Contract Administrator of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Contract Administrator.

3.2 Installation

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

.2 Provide welded structural steel stands for floor mounting of heat exchangers. Bolt stand to floor.

.3 Ensure installation permits removal of tubes without disturbing installed equipment or piping.

.4 Refer to Drawings for details of installation and piping connections.

3.3 Cleaning

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

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

3.4 Protection

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by heat exchanger installation.

END OF SECTION

AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

1. GENERAL

1.1 Summary

.1 Section Includes:

.1 Materials, components, and installation for energy recovery equipment.

1.2 References

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE):

.1 ASHRAE 84, Method of Testing Air-to-Air Heat/Energy Exchangers (ANSI approved).

.2 ASHRAE/IES 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.3 ASHRAE 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

.1 Safety Data Sheets (SDS).

.3 NFPA:

.1 NFPA 496, Standard for Purged and Pressurized Enclosures for Electrical Equipment.

.2 NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.

.4 Manitoba Workplace Safety and Health Act (WSHA).

.5 Underwriters Laboratories of Canada (ULC).

.1 CAN/ULC S102, Test for Surface Burning Characteristics of Building Materials and Assemblies.

.2 UL 900, Standard for Safety for Air Filter Units.

.6 Canadian Standards Association (CSA).

.7 American Society for Testing and Materials (ASTM).

.1 ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

.2 ASTM C1338, Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facing.

.3 ASTM C1104, Standard Test Method for Determining the water Vapor Sorption of Unfaced Mineral Fiber Insulation.

.8 Air Movement and Control Association (AMCA).

.9 Electrical Testing Laboratories (ETL).

1.3 Action and Informational Submittals

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications, and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Certified fan sound-power ratings.

.3 Energy recovery performance at specified operating conditions including efficiencies.

.4 Heating and cooling coil performance at specified operating conditions.

.2 Shop Drawings:

.1 Submit Shop Drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Certified fan sound-power ratings.

.3 Energy recovery performance at specified operating conditions including efficiencies.

.4 Heating and cooling coil performance at specified operating conditions.

.5 Roof curbs and accessories.

.3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

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

.4 Closeout Submittals:

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

.5 Certificates:

.1 Catalogued or published ratings: obtained from tests carried out by manufacturer or those ordered from independent testing agency signifying adherence to codes and standards in force.

1.4 Delivery, Storage and Handling

.1 Packing, shipping, handling, and unloading:

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

.2 The unit is not to be used for temporary heating, cooling or ventilation during construction.

1.5 Maintenance

.1 Extra Materials:

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Furnish list of individual manufacturer's recommended spare parts for equipment include:

.1 Bearings and seals.

.2 Addresses of suppliers.

.3 Filters: Two set(s) of each type of filter specified.

.4 Fan Belts: One set of belts for each belt-driven fan in energy recovery units.

.2 List of specialized tools necessary for adjusting, repairing, or replacing.

1.6 Coordination

.1 Coordinate sizes and locations of concrete bases with actual equipment provided.

.2 Coordinate electrical and controls requirements.

.3 Coordinate access and placement requirements.

2. PRODUCTS

2.1 Dual Core Reverse Flow Energy Recovery Ventilator

.1 Manufacturers and Products:

.1 Acceptable Manufacturers:

.1 Engineered Air.

.2 Tempeff.

.3 SolutionAir.

.2 Performance Requirements:

.1 NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

.2 ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1.

.3 System must utilize a regeneration reversing fresh air / exhaust air recovery methodology with a minimum 70 second cycle time.

.4 Winter: 90% plus or minus 5% sensible and 70% plus or minus 5% latent at equal airflow.

.5 Summer: 80% plus or minus 5% sensible and 70% plus or minus 5% latent at equal airflow.

.6 The maximum allowable cross contamination in a balance flow system is 4% return air.

.7 No defrost. Unit requires no frost protection in applications down to -40 ºC.

.8 Maximum allowable face velocity across heat exchangers: 2.3 m/s.

.3 Construction:

.1 General:

.1 Unit is to be of modular construction to facilitate splitting into sections to allow for installation and removal without modification to the building structure. Coordinate size requirements with the installing contractor.

.2 Unit is to be capable of running at 50% of the scheduled airflow with no loss of energy recovery efficiency.

.2 Housing:

.1 Minimum 18 gauge satin coat galvanized sheet metal.

.2 Surfaces shall be cleaned with a degreasing solvent to remove oil and metal oxides and primed with a two-part acid based etching primer.

.3 Finish coat shall be an electrostatically applied enamel, to all exposed surfaces.

.4 All unprotected metal and welds shall be factory coated.

.5 Unit to come with double wall construction and have two-part epoxy coated steel on both interior and exterior of the unit.

.6 All high pressure 1250 Pa to 2250 Pa fan sections shall be constructed of 14 gauge (2.0mm) metal. Continuous high-pressure sealant shall be provided between all panels.

.7 All walls, roofs and floors shall be of formed construction, with at least two breaks at each joint. Joints shall be secured by sheet metal screws or pop rivets. Wall and floor joints shall be broken in and on all outdoor units, roof joints broken out (exposed) for rigidity. All joints shall be caulked with a water-resistant sealant.

.8 All units shall be internally insulated with 50mm thick lb./cu.ft. (24 kg./cu.m.) density insulation.

.9 The unit shall include an integral base with lifting points.

.3 Access Doors:

.1 Access doors shall be large enough for easy access.

.2 Insulated: RSI 1.14 m^2 ºC/W per 25 mm of wall thickness.

.3 Inner and outer sections of panel constructed of 0.6 mm, galvanized steel.

.4 Module to module assembly shall be accomplished with self-adhering, Viton (FPM) gaskets.

.5 Provide test data demonstrating less than 5 mm deflection for an unsupported 1220 mm x 1220 mm panel under 7.5 kPa pressure.

.6 Access Doors flush mounted to cabinetry, minimum of two (2) hinges, full size handle assembly and tie-back clips.

.7 All access doors shall be sealed with permanently applied bulb-type gasket.

.8 Access doors to allow full access to motor, drive, and bearings, filters, dampers, damper operators and coils.

.9 Access doors to include locking latches on control section.

.10 Doors located on sections with positive pressure shall have a clear warning label and a safety device must be affixed.

.4 Drain Pan:

.1 The units shall be supplied with cleanable, positive draining, drain pan(s).

.2 The drain pan(s) shall be marine grade aluminum.

.3 The drain pan(s) shall be designed as necessary to prevent carryover of water droplets beyond the drain pan to 1.40 mL/m^2 (0.0044 oz/ft^2) of face area per hour under peak sensible and peak dew-point conditions, accounting for both latent load and a coil face velocity 20% above the design velocity.

.5 Hardware:

.1 All hardware, hinges, handles and fasteners shall be non-corrosive.

.2 All external hardware, handles and fasteners, shall be non-corrosive 300 series stainless steel.

.3 All internal fasteners used on insulated panels shall be non-corrosive aluminum or 300 Series stainless steel.

.4 Energy Recovery Cores:

.1 General:

.1 The cores shall be removable for cleaning without disconnecting the ductwork or disassembly of other component sections.

.2 Materials:

.1 Corrugated high grade aluminum.

.2 Stainless steel heat exchanger frames.

.3 Damper Section:

.1 Low leakage insulated dampers operated by fast acting electric or pneumatic actuators. Actuators shall be suitably rated for the electrical hazard exposure as indicated in electrical drawings and specifications.

.2 Dampers capable of orienting to close off outside air to the building without needing external shut off dampers.

.3 Dampers capable of orienting to allow 100% recirculation of air without using heat recovery device for off peak or unoccupied heating modes.

.4 Recovery cycles controlled by internal programmed thermostats measuring both supply and exhaust air, optimizing performance of both heat recovery and free cooling modes.

.5 Dampers blades galvanized steel or extruded aluminum.

.6 Damper and actuator manufacturers must provide the following:

.1 Written documentation that the dampers are capable of a minimum duty cycle of 500,000 cycles annually.

.2 Written warranty on damper and actuator manufacturers letterhead confirming the warranty.

.5 Fans:

.1 Supply and return fans shall be backward inclined airfoil direct-drive plenum fans or belt-drive blowers.

.2 Belt-drive blowers shall have a dual belt arrangement.

.3 Fan assemblies including fan and motor dynamically balanced by the manufacturer on all three planes and at all bearing supports.

.4 Size fans to ensure maximum fan RPM is below first critical speed.

.5 Bearings and Shafts (belt-drive):

.1 Self-aligning, grease lubricated, ball or roller bearings with extended copper lubrication lines to access side of unit.

.2 Heavy duty, greaseable, pillow block flange bearings. Bronze or plastic bearings are not acceptable.

.3 Bearing minimum diameter: 20 mm (¾").

.4 20 mm (¾") chromium shafts, maximum of four (4) shafts per unit.

.5 Grease fittings attached to the fan base assembly near access door: either factory or field installed.

.6 Extended copper lubrication lines to access side of unit.

.6 Fan and motor mounted internally on galvanized, steel base. Fan and motor assembly shall be mounted on rubber-in-shear vibration type isolators inside cabinetry.

.7 Fan motors will be totally enclosed fan cooled.

.6 Controls:

.1 Review Sequence of Operations for HVAC Section 23 09 93.11 and Process & Instrumentation Diagrams for HVAC for all control components to be supplied with these units.

.2 Unit Control Panel:

.1 NEMA rated to installation area electrical hazard Zone rating and moisture / corrosive category rating per electrical drawings and specifications.

.2 Contains unit PLC, electrical contacts, electro-pneumatic valves, and all accessories to operate ERV's in the following modes:

.1 Heat Recovery.

.2 Free Cooling.

.3 Recirculation.

.3 Integral hardwired low limit freeze protection set at 4°C with enable / disable and bypass timers for start-up and anti-nuisance.

.4 Inputs from Plant Control System (PCS):

.1 Start/Stop.

.2 Discharge air temperature setpoint.

.3 Winter/Summer mode.

.5 Outputs to PCS:

.1 Damper Actuator Failure / Failure of pneumatic system (if applicable).

.2 Dirty Filter.

.3 General Alarm.

.4 Heating valve position.

.3 Variable Frequency Drives (VFD's):

.1 Integral to unit.

.2 Inputs from PCS:

.1 Start/Stop.

.2 Speed.

.3 Outputs to PCS:

.1 Status.

.2 Alarm.

.3 Speed.

.4 Acceptable Product: Schneider Altivar 600 series.

.4 Pneumatic Compressor:

.1 If a pneumatic actuator is used on the flow diverting damper(s) the unit shall be provided with a dedicated and integral air compressor, controls, filters, gauges, air dryer (as required) and drainage.

.2 If the ERV is to be installed in an electrically classified area the compressor assembly will have to be remote mounted in a non-classified area and piped to the actuator.

.3 The compressor is to be oil-less and permanently lubricated.

.4 Provide pressure switch to indicate loss of or low pneumatic press to the PCS.

.5 The compressor is to be rated for a minimum of 25,000 hours of running time with a receiver tank sized for a maximum 25% duty cycle.

.7 Electrical:

.1 Bears CSA or ULc listing label for entire assembly. Units with only components bearing third party safety listing are unacceptable.

.2 Control panels supplied loose and to be remotely field mounted in unclassified area as required.

.3 Wiring Termination: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. All wires shall be number tagged and cross-referenced to the wiring diagram for ease of troubleshooting.

.4 Provide explosion-proof motors and wiring for classified applications.

.5 Electrical components not rated for classified areas that are exposed to classified atmospheres will be in an enclosure meeting the requirements of NFPA 496.

.8 Filters:

.1 Filter section with stainless steel filter racks and guides with hinged and latching access doors on both sides for side loading and removal.

.2 Filter media shall be UL 900 listed, Class I or Class II.

.3 Average capture efficiency of 70% in the 3-10 micron particle range. Minimum Efficiency Reporting Value (MERV) 8 at 2.5 m/s per ASHRAE 52.2.

.4 Diamond grid with 98% open area to provide support for the media.

.5 Bond the media-to-media support to ensure pleat stability enclosure the media with a rigid moisture resistant, heavy duty kraft board.

.6 Bond the filter pack to the inside periphery of the frame to eliminate air bypass.

.7 Material: Non-Woven Reinforced Cotton Rayon. Angle arrangement with 50 mm deep, pleated, disposable panel filters.

.8 When indicated on the equipment schedule the supply airstream will be provided with a combination particulate and molecular media filter with an efficiency of 60% per ISO16890 and a MERV8 particulate filter rating. (Camfil City Pleat 300 or approved equal).

.9 Air Filter Gauges:

.1 Provide each filter bank with "Dwyer 2000 magnehelic" air filter gauge (or approved equal) complete with static pressure tips and aluminum tubing all factory installed. Filter gauge to have a range of 0 to 500 Pa (0 to 2”).

.10 Pressure Transmitters:

.1 Provide one (1) pressure transmitter for each bank of filters, including for each position of prefilter to provide continuous monitoring of filter pressure drop at the PCS.

.1 When installed in an electrically classified area, the transmitter to be suitable for installation in the classified area and designed as explosion proof.

.9 Heating Coils:

.1 General:

.1 Access to coils from both sides of unit for service and cleaning.

.2 Enclose coil headers and return bends fully within unit casing.

.3 Coil connections to extend a minimum of 125 mm beyond unit casing for ease of installation.

.4 Drain and vent connections provided exterior to unit casing.

.5 Coil connections factory sealed with grommets on interior and exterior and gasket sleeve between outer wall and liner where each pipe extends through the unit casing to minimize air leakage and condensation inside panel assembly.

.6 Coils removable through side and top panels of unit without the need to remove and disassemble the entire section from the unit.

.2 Certification:

.1 In accordance with AHRI Standard 410 and bear the AHRI label. Coils exceeding the scope of the manufacturer's certification and/or the range of AHRI's standard rating conditions will be considered provided the manufacturer is a current member of the AHRI Air-Cooling and Air-Heating Coils certification programs and that the coils have been rated in accordance with AHRI Standard 410. Manufacturer must be ISO 9002 certified.

.3 Headers:

.1 Seamless copper tubing.

.2 Intruded tube holes to provide maximum brazing surface for tube to header joint, strength, and inherent flexibility.

.3 Diameter varies with fluid flow requirements.

.4 Fins:

.1 0.2 mm aluminum plate.

.2 Full drawn collars to provide a continuous surface cover over the entire tube.

.3 Tubes:

.1 Mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length.

.2 16 mm OD seamless copper, 0.6 mm nominal tube wall thickness, expanded into fins, brazed at joints.

.3 Soldered U-bends, 0.6 mm.

.4 Coil connections:

.1 RFWN Class 150# flanged carbon steel.

.2 Vent and drain fittings furnished on connections, exterior to air handler.

.3 Vent connections provided at the highest point to assure proper venting.

.4 Drain connections provided at the lowest point to insure complete drainage.

.5 Coil casings shall be a formed channel frame of galvanized steel.

.5 Finishes:

.1 Corrosion Protection: Baked on phenolic coating suitable for three thousand (3000) hours salt spray per ASTM-B117.

.2 No exposed copper.

.3 Acceptable Products:

.1 Heresite P413.

.2 Or approved equivalent.

.10 Capacity and Performance: as scheduled.

3. EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Install in accordance with manufacturers recommendations.

.2 Provide flexible connection for electrical power and hot water piping.

.3 Support independently of adjacent ductwork with flexible connections.

.4 Install units with clearances for service and maintenance. Install ducts and piping adjacent to units to allow service and maintenance.

.5 Coordinate housekeeping pad size required with structural contractor.

.6 Connect hot water piping to supply and return coil tappings with shutoffs, balancing valve and union or flanges.

.7 Install filters upstream of heating coils prior to fan operation.

3.3 Field Quality Control

.1 Tests:

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

3.4 Cleaning

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

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools, and equipment.

END OF SECTION

1. GENERAL

1.1 Scope

.1 Packaged, indoor DX cooling unit with 100% outdoor air capability.

.2 Outdoor condensing unit.

.3 Operating controls.

.4 Remote panel.

1.2 References

.1 Meet the requirements of CGA/CSA, Provincial and Municipal Codes and be CSA listed.

.2 Test and rate cooling systems to AHRI Standard 210.

.3 Units shall be products of manufacturers who provide local service personnel from factory representative, franchised dealer, or certified maintenance service shop.

.4 AMCA 99, Standard Handbook.

.5 AMCA 210, Laboratory Methods of Testing Fans for Rating Purposes.

.6 AMAC 300, Test Code for Sound Rating Air Moving Devices.

.7 AMAC 301, Method of Calculating Fan Sound Ratings from Laboratory Test Data.

.8 NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.

.9 UL 900 – Determining the quantity of smoke generated and the combustibility of air filter units.

1.3 Submittals

.1 Provide submittals in accordance with Section 01 33 00 and the following:

.1 Manufacturer's descriptive literature for materials.

.2 Submit certified fan performance curves with system operating conditions indicated per equipment schedules. Select fans at maximum efficiency for specified duty.

.3 Submit certified sound power levels for make-up air unit inlet and outlet and casing radiation at rated capacity in accordance with AMCA. List for individual octave bands in dB referenced to A rating.

.4 Dampers, including housings, linkages, and operators.

.5 Air Filters: Media, efficiency rating, velocity, pressure drop charts and capacities. Indicate mounting method and arrangement.

.6 Heating and cooling coil performance at specified operating conditions.

.7 Materials of construction and Electrical Classification: Indicate material and gauge of all construction components and area classification.

.8 Mass distribution drawings: show point loads and recommended method of unit installation.

.9 Detailed composite wiring diagrams showing factory installed wiring, including wiring of control components.

1.4 Warranty

.1 Provide five (5) year, limited warranty on compressor units.

2. PRODUCTS

2.1 Air Handling Unit

.1 General:

.1 Self-contained, packaged, factory assembled and pre-wired Air Handling Unit (AHU) consisting of a cabinet and frame, supply fan, DX cooling coil, hydronic heating coil outdoor air, return air dampers, controls, and air filter with summer and winter positions.

.2 Supply, return and outdoor air connections air connection as indicated on drawings.

.2 Casing Construction:

.1 1.3 mm (18 gauge), satin coat, galvanized sheet metal.

.2 Surfaces cleaned with degreasing solvent to remove oil and metal oxides and primed with a two-part acid based etching primer. Finish coat electrostatically applied enamel, to all exposed surfaces. All unprotected metal and welds factory coated.

.3 Walls, roofs, and floors of formed construction with at least two breaks at each joint. Joints secured by sheet metal screws or pop rivets. All joints caulked with a waterproof sealant.

.4 Access doors:

.1 Hinged access doors with e-profile gasket, fully lined, minimum of two (2) lever handles, operable from both inside and outside of unit.

.2 Provided to give access to the following components: fans and motors, filters, dampers and operators, access plenums, and electrical control panels.

.3 Access doors sized large enough for easy access. Removal of screwed wall panels is not acceptable.

.4 Sized sufficiently large to permit replacement of filters from outside of unit.

.5 Insulation:

.1 All units shall be internally insulated with 50 mm (2") thick, 24 kg/m³ (1½ lb/ft³) density insulation.

.2 Insulation secured to metal panels with a fire-retardant adhesive and welded steel pins at 400 mm (16") o/c. All longitudinal insulation joints and butt ends covered by a sheet metal break to prevent erosion of exposed edges. Drain pans and all floor areas insulated on the underside.

.6 Cooling Coil Drain Pan:

.1 Fabricated of stainless steel and integral to the floor paneling.

.2 Minimum 50 mm (2") deep with welded corners.

.3 Drain pans extend a minimum of 150 mm (6") downstream of coil face and are provided with a 40 mm (1½") S.S. M.P.T. drain connection.

.4 Drain pans must have a fast pan and be sloped and pitched such that there is no standing water. Provide intermediate fast pans between cooling coils where required for effective moisture removal.

.7 Support:

.1 Indoor, suspended units provided with 13 mm (½") holes in the base channels to be suitable to accommodate hanger rods to support entire weight of unit from rods at hole locations (rods supplied by others).

.8 Fan:

.1 Centrifugal fans rated in accordance with AMCA Standard Test Code, Bulletin 210.

.2 Manufacturer a member of AMCA.

.3 Fans and fan assemblies dynamically balanced during factory test run.

.4 Fan shafts selected for stable operation at least 20% below the first critical RPM and provided with a rust inhibiting coating.

.5 Single low pressure forward curved fans of 450 mm (18") or less diameter equipped with permanently lubricated cartridge ball bearings supported by a 3 point "spider" bearing bracket in the fan inlets. All other forward curved fan assemblies equipped with greaseable pillow block bearings supported on a rigid structural steel frame.

.6 Provide adjustable drives coated with rust inhibiting coating.

.7 Locate motor, fan bearings, and drive assembly inside fan plenum to minimize bearing wear and to allow for internal vibration isolation of the fan-motor assembly, where required. Motor mounting adjustable to allow for variations in belt tension.

.8 Provide vibration isolators for fan-motor assemblies. Bolt isolators to steel channel welded to unit floor, which is welded to the structural frame of the unit. Isolators to be neoprene-in-shear type for single 230 mm (9") 380 mm (15") diameters forward

curve fans. All other fans to incorporate vertical spring type isolators with leveling bolts, bridge bearing waffled pads with minimum 25 mm (1") static deflection designed to achieve high isolation efficiency. Attach fans to discharge panel by a polyvinyl chloride coated polyester woven fabric with a sealed double locking fabric to metal connection.

.9 Provide single extended grease line from far side to access side bearing.

.10 ODP (open drip proof) fan motors; super-E high efficiency.

.9 Filters:

.1 Provide filter sections with adequately sized access doors to allow easy removal of filters from one side as noted on the drawings.

.2 Side removal 50 mm (2") filters slide into a formed metal track, sealing against metal spacers at each end of the track.

.3 50 mm (2") Pleated Panel Disposable Filters:

.1 Natural and synthetic fiber media.

.2 Rust resistant support grid and high-wet strength beverage board enclosing frame with diagonal support members bonded to the air entering and air exiting side of each pleat.

.3 Permanent re-usable metal enclosing frame.

.4 Filter media minimum efficiency of 30-35% on ASHRAE Standard 52.1, and a minimum of MERV 8 per ASHRAE 52.2. Rated U.L. Class 2.

.5 For Electrical Room, Control Room or when indicated on the equipment schedule the supply airstream will be provided with a 100mm combination particulate and molecular media filter with an efficiency of 60% per ISO16890 and a MERV8 particulate filter rating. (Camfil City Pleat 400 or approved equal).

.6 Provide each filter bank with "Dwyer 2000 magnehelic" air filter gauge (or approved equal) complete with static pressure tips and aluminum tubing all factory installed. Filter gauge to have a range of 0 to 500 Pa (0 to 2”).

.10 Evaporator Coil:

.1 Construction: Copper tube aluminum fin coil assembly.

.2 Drain pan: Sloped stainless steel.

.3 Finishes

.1 Corrosion Protection: Baked on phenolic coating suitable for three thousand (3000) hours salt spray per ASTM-B117.

.2 No exposed copper.

.3 Acceptable Products:

.1 Heresite P413.

.2 Or approved equivalent.

.4 Capacity and Performance: as scheduled.

.11 Hydronic Heating Coil:

.1 General:

.1 Access to coils from both sides of unit for service and cleaning.

.2 Enclose coil headers and return bends fully within unit casing.

.3 Coil connections to extend a minimum of 125 mm beyond unit casing for ease of installation.

.4 Drain and vent connections provided exterior to unit casing.

.5 Coil connections factory sealed with grommets on interior and exterior and gasket sleeve between outer wall and liner where each pipe extends through the unit casing to minimize air leakage and condensation inside panel assembly.

.6 Coils removable through side and top panels of unit without the need to remove and disassemble the entire section from the unit.

.2 Certification:

.1 In accordance with AHRI Standard 410 and bear the AHRI label. Coils exceeding the scope of the manufacturer's certification and/or the range of AHRI's standard rating conditions will be considered provided the manufacturer is a current member of the AHRI Air-Cooling and Air-Heating Coils certification programs and that the coils have been rated in accordance with AHRI Standard 410. Manufacturer must be ISO 9002 certified.

.3 Headers:

.1 Seamless copper tubing.

.2 Intruded tube holes to provide maximum brazing surface for tube to header joint, strength, and inherent flexibility.

.3 Diameter varies with fluid flow requirements.

.4 Fins:

.1 0.2 mm aluminum plate.

.2 Full drawn collars to provide a continuous surface cover over the entire tube.

.3 Tubes:

.1 Mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length.

.2 16 mm OD seamless copper, 0.6 mm nominal tube wall thickness, expanded into fins, brazed at joints.

.3 Soldered U-bends, 0.6 mm.

.4 Coil connections:

.1 RFWN Class 150# flanged carbon steel.

.2 Vent and drain fittings furnished on connections, exterior to air handler.

.3 Vent connections provided at the highest point to assure proper venting.

.4 Drain connections provided at the lowest point to insure complete drainage.

.5 Coil casings shall be a formed channel frame of galvanized steel.

.5 Finishes

.1 Corrosion Protection: Baked on phenolic coating suitable for three thousand (3000) hours salt spray per ASTM-B117.

.2 No exposed copper.

.3 Acceptable Products:

.1 Heresite P413.

.2 Or approved equivalent.

.6 Capacity and Performance: as scheduled.

.12 Dampers:

.1 Return air damper extruded aluminum low leak airfoil Tamco Series 1000 or approved equivalent.

.2 Outdoor air damper insulated aluminum low leak airfoil Tamco Series 9000 or approved equivalent.

.3 Dampers parallel blade type.

.3 Outside Air / Return Air Mixing Section:

.1 Performance: Capable of providing 100% outside air with return air relief for free cooling.

.2 Damper Operators:

.1 24 V,

.2 Spring return.

.3 Modulating 0 – 10 VDC / 4 – 20 mA input control.

.4 2 – 10 VDC / 4 – 20 mA position feedback.

.5 Ambient temperature range -40°C to +50°C.

.6 Outside air damper fails to closed position.

.7 Return air damper fails to open position.

.4 Controls:

.1 Review Sequence of Operations for HVAC Section 23 09 93.11 and Process & Instrumentation Diagrams for HVAC for all control components to be supplied with these units.

.2 Unit Control Panel:

.1 Unit will be provided complete with a unitary DDC controller that is fully integrated into the Plant Control System (PCS).

.2 Automatic controls shall be housed in a control panel mounted in or on the air handling unit, which will meet that standard of the specific installation.

.3 Panel to include indication and troubleshooting LED lights, multi-meter set point and sensor temperature test points, and a common alarm contact in the event of equipment failure. Information can be accessed from a handheld device or laptop computer for improved access to control settings.

.4 Provide a system of motor control, including all necessary terminal blocks, motor contactors, motor overload protection, grounding lugs, control transformers, auxiliary contactors and terminals for the connection of external control devices or relays.

.5 Unit controls will be complete with an ambient air temperature sensor to determine heating or cooling mode.

.6 Fire alarm circuits (where required) shall be powered from a relay in unit circuitry.

.7 Integral hard-wired low limit freeze protection set at 4°C with enable / disable and bypass timers for start-up and anti-nuisance.

.8 Inputs from Plant Control System (PCS):

.1 Start/Stop.

.2 Discharge air temperature setpoint.

.3 Winter/Summer mode.

.9 Outputs to PCS:

.1 Fan run status.

.2 Dirty Filter.

.3 General Alarm.

.4 Damper position.

.5 Heating valve position.

.6 Mechanical cooling status.

2.2 Condensing Unit

.1 $_{C}$ETL, ETL$_{US}$ approved.

.2 Designed for a minimum of 8°C (15°F) liquid subcooling.

.3 Operate down to 10°C (50°F) as standard.

.4 Multiple compressor/condenser circuits separate from each other.

.5 Suction and liquid lines extended to the outside of the cabinet.

.6 Service ports fitted with Schraeder fittings connected to the suction and discharge lines for charging or pressure gauge readings. Semi-hermetic units also incorporate liquid line service ports and liquid line manual shutoff valves.

.7 Controls for hermetic compressor units include compressor and condenser fan motor contactors, control circuit transformer, cooling relays, non-recycling pumpdown relays, ambient compressor lockout, manual reset high pressure controls and automatic reset low pressure controls. Head pressure actuated fan cycling control provided on all multiple condenser fan units.

.8 Provide five (5) minute anti-cycle timers.

.9 Provide hot gas bypass connection on the lead compressor.

.10 Refrigeration specialties such as solenoid valves, TX valves, etc., to be supplied and installed by refrigeration contractor.

.11 Unit to have a minimum of four (4) compressors.

3. EXECUTION

3.1 Installation

.1 Suspend indoor units from ceiling or mount on concrete pads as indicated.

.2 Install outdoor condensing unit on a corrosion resistant galvanized steel or aluminum frame suitable to the dimensions and weight of the unit, with rubber support bases.

.3 Provide flexible duct connections for supply and return ducting.

3.2 Performance

.1 Refer to Equipment Schedules.

END OF SECTION

1. GENERAL

1.1 Summary

.1 Section Includes:

.1 Materials and installation for self-contained single zone, hot water, packaged make-up air unit.

1.2 References

.1 American National Standards Institute (ANSI)/Air Conditioning, Heating and Refrigeration Institute (AHRI):

.1 AHRI 270, Sound Rating of Outdoor Unitary Equipment.

.2 ANSI/UL 1995 B, Standard for Heating and Cooling Equipment.

.3 Canadian Standards Association (CSA):

.1 CSA C22.1, Canadian Electrical Code Handbook.

.4 Health Canada / Workplace Hazardous Materials Information System (WHMIS):

.1 Safety Data Sheets (SDS).

.5 National Fire Protection Association:

.1 NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.

1.3 Action and Informational Submittals

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications, and datasheet for packaged make-up air unit.

.3 Shop Drawings:

.1 Submit Shop Drawings to indicate project layout and dimensions; indicate:

.1 Equipment, control assemblies, thermostatic controls, auxiliaries and hardware, and recommended ancillaries.

.2 Dimensions, internal and external construction details, recommended method of installation, mounting curb details.

.3 Detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices of ancillaries, accessories, and controllers.

.4 Fan performance curves.

.5 Details of vibration isolation.

.4 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals include data as follows:

.1 Provide for units, manufacturer's name, type, year, number of units, and capacity.

2. PRODUCTS

2.1 Make-Up Air Unit – Hydronic Heating

.1 General:

.1 Make-up air unit with integral heating.

.2 Fully assembled at the factory.

.3 Insulated metal cabinet, outdoor air intake, glycol coil, motorized intake damper, sensors, curb assembly, filter assembly for intake air with summer and winter filter positions, supply air blower assembly, and an electrical control center.

.4 All specified components and internal accessories factory installed and tested and prepared for single-point electrical connection.

.5 Unit and all components CSA/ULc approved and bears the label.

.6 Capacity: as scheduled.

.2 Cabinet:

.1 Formed, double wall insulated metal cabinet.

.2 Fabricated to permit access to internal components for maintenance.

.3 Underside of unit to have formed metal panels covering base panel insulation.

.4 Outside casing: 1.3 mm G60 galvanneal steel painted with polyester urethane paint.

.5 Base rail is 1.6 mm, galvanized (G90) steel.

.6 Internal assemblies: 0.7 mm, galvanized (G90) steel except for motor supports which are 2.0 mm, galvanized (G90) steel.

.7 Cabinet Insulation:

.1 Comply with NFPA 90A and NFPA 90B and erosion requirements of UL 181.

.2 25 mm fibreglass, semi-rigid type.

.3 Fire Hazard Classification: Maximum flame spread of 25 and smoke developed of 50, when tested in accordance with ASTM C 411.

.4 Cover full interior coverage of entire cabinet including walls, roof, and floor.

.3 Access panels:

.1 Equip unit with insulated, hinged access panels to provide easy access to all major components.

.2 Fabricated of 1.3 mm galvanized G90 steel.

.4 Supply Air Blower Assembly:

.1 Belt driven, double width, and double inlet, forward curve blower.

.2 Motor: TEFC, 1,800 rpm.

.3 Assembly mounted on heavy gauge galvanized rails and further mounted on 30 mm thick neoprene vibration isolators.

.4 Blower assemblies:

.1 Statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.

.2 Centrifugal blower housing:

.1 Formed and reinforced steel panels to make curved scroll housing with shaped cut-off.

.3 Forward curved blower (fan) wheels:

.1 Galvanized or aluminum construction with inlet flange and shallow blades curved forward in direction of airflow.

.2 Mechanically attached to shaft with set screws.

.4 Blower performance factory tested for flow rate, pressure, power, air density, rotation speed and efficiency.

.5 Ratings are to be established in accordance with AMCA 210, “Laboratory Methods of Testing Fans for Rating.”

.5 Motors:

.1 Heavy-duty, permanently lubricated type to match the fan load and furnished at the scheduled voltage, phase, and enclosure.

.2 Drives sized for a minimum of 150% of driven horsepower and pulleys shall be fully machined cast-type, keyed and fully secured to the fan wheel and motor shafts.

.3 Motors supplied with an adjustable drive pulley.

.5 Control Center:

.1 Provide electrical control center where all high and low voltage connections are made.

.2 Constructed to permit single-point power supply connection.

.6 Hydronic Heating Coil:

.1 General:

.1 Access to coils from both sides of unit for service and cleaning.

.2 Enclose coil headers and return bends fully within unit casing.

.3 Coil connections to extend a minimum of 125 mm beyond unit casing for ease of installation.

.4 Drain and vent connections provided exterior to unit casing.

.5 Coil connections factory sealed with grommets on interior and exterior and gasket sleeve between outer wall and liner where each pipe extends through the unit casing to minimize air leakage and condensation inside panel assembly.

.6 Coils removable through side and top panels of unit without the need to remove and disassemble the entire section from the unit.

.2 Certification:

.1 In accordance with AHRI Standard 410 and bear the AHRI label. Coils exceeding the scope of the manufacturer's certification and/or the range of AHRI's standard rating conditions will be considered provided the manufacturer is a current member of the AHRI Air-Cooling and Air-Heating Coils certification programs and that the coils have been rated in accordance with AHRI Standard 410. Manufacturer must be ISO 9002 certified.

.3 Headers:

.1 Seamless copper tubing.

.2 Intruded tube holes to provide maximum brazing surface for tube to header joint, strength, and inherent flexibility.

.3 Diameter varies with fluid flow requirements.

.4 Fins:

.1 0.2 mm aluminum plate.

.2 Full drawn collars to provide a continuous surface cover over the entire tube.

.3 Tubes:

.1 Mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length.

.2 16 mm OD seamless copper, 0.6 mm nominal tube wall thickness, expanded into fins, brazed at joints.

.3 Soldered U-bends, 0.6 mm.

.4 Coil connections:

.1 RFWN Class 150# flanged carbon steel.

.2 Vent and drain fittings furnished on connections, exterior to air handler.

.3 Vent connections provided at the highest point to assure proper venting.

.4 Drain connections provided at the lowest point to insure complete drainage.

.5 Coil casings shall be a formed channel frame of galvanized steel.

.5 Finishes:

.1 Corrosion Protection: Baked on phenolic coating suitable for three thousand (3000) hours salt spray per ASTM-B117.

.2 No exposed copper.

.3 Acceptable Products:

.1 Heresite P413.

.2 Or approved equivalent.

.6 Capacity and Performance: as scheduled.

.7 Motorized Inlet Air Damper:

.1 Low leakage type and factory installed.

.2 Outdoor air damper insulated aluminum low leak airfoil Tamco Series 9000 or approved equivalent.

.3 Dampers parallel blade type.

.4 Damper Operators:

.1 24 V.

.2 Spring return.

.3 Two position.

.4 Position feedback.

.5 Ambient temperature range -40°C to +50°C.

.6 Outside air damper fails to open position.

.8 Controls:

.1 Review Sequence of Operations for HVAC Section 23 09 93.11 and Process & Instrumentation Diagrams for HVAC for all control components to be supplied with these units.

.2 Provide a system of motor control, including all necessary terminal blocks, motor contactors, motor overload protection, grounding lugs, control transformers, auxiliary contactors and terminals for the connection of external control devices or relays.

.3 Fire alarm circuits (where required) shall be powered from a relay in unit circuitry.

.4 Integral hardwired low limit freeze protection set at 4°C with enable / disable and bypass timers for start-up and anti-nuisance.

.5 Inputs from Plant Control System (PCS):

.1 Start/Stop.

.2 Discharge air temperature setpoint.

.3 Winter/Summer mode.

.6 Outputs to PCS:

.1 Fan run status.

.2 Dirty Filter.

.3 General Alarm.

.4 Damper position.

.5 Heating valve position.

.9 Filter:

.1 Filter section with stainless steel filter racks and guides with hinged and latching access doors on both sides for side loading and removal.

.2 Filter media shall be UL 900 listed, Class I or Class II.

.3 Average capture efficiency of 70 percent in the 3-10 micron particle range. Minimum Efficiency Reporting Value (MERV) 8 at 2.5 m/s per ASHRAE 52.2.

.4 Diamond grid with 98 percent open area to provide support for the media.

.5 Bond the media-to-media support to ensure pleat stability enclosure the media with a rigid moisture resistant, heavy duty kraft board.

.6 Bond the filter pack to the inside periphery of the frame to eliminate air bypass.

.7 Material: Non-Woven Reinforced Cotton Rayon. Angle arrangement with 50 mm deep, pleated, disposable panel filters.

.8 When indicated on the equipment schedule the supply airstream will be provided with a combination particulate and molecular media filter with an efficiency of 60% per ISO16890 and a MERV8 particulate filter rating. (Camfil City Pleat 300 or approved equal).

.9 Air Filter Gauges:

.1 Provide each filter bank with "Dwyer 2000 magnehelic" air filter gauge (or approved equal) complete with static pressure tips and aluminum tubing all factory installed. Filter gauge to have a range of 0 to 500 Pa (0 to 2”).

3. EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Install as per manufacturers' instructions on concrete pad.

3.3 Demonstration

.1 Training: in accordance with Section 01 91 31 - Commissioning Plan.

3.4 Cleaning

.1 Perform cleaning operations as specified in Section 01 74 11 - Cleaning and in accordance with manufacturer's recommendations.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools, and equipment.

END OF SECTION

1. GENERAL

1.1 Description

.1 For additional information, refer to Section 21 05 01 - Common Work Results for Mechanical and Division 1 - General Conditions of the Construction Contract.

.2 For a list of applicable codes and standards, refer to Section 21 05 01 - Common Work Results for Mechanical.

.3 The Construction Contractor shall be responsible for coordinating all aspects of this Work.

.4 Locations of equipment, ductwork, pipework, and all associated appurtenances indicated on the Drawings are approximate only. The Construction Contractor is responsible for checking and coordinating the locations of equipment, ductwork, pipework, and all associated appurtenances and shall make any necessary adjustments in positions to conform with the architectural features, other services, symmetry and lighting arrangements.

1.2 Scope of Work

.1 The Scope of Work for this Section includes, but is not limited to, the following:

.1 Materials and procedures for the provision and installation of explosion proof and non-explosion proof hydronic unit heaters, hydronic cabinet unit heaters, hydronic baseboard heaters, and hydronic radiant ceiling panels as scheduled in drawings .

1.3 Related Work

.1 This Section may not contain all materials, equipment and requirements required for the completion of this project. This Section is to be read in conjunction with the remaining Sections of Division 21, 22 and 23 and all related works.

.2 Division 1 forms an integral part of Division 21, 22 and 23.

1.4 References

.1 Except as specified herein, the latest edition of the standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

.2 In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

.3 Canadian Standards Association (CSA International):

.1 CSA C22.1, General Requirements, Canadian Electrical Code, Part I.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS):

.1 Safety Data Sheets (SDS).

.5 National Fire Protection Association (NFPA):

.1 NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.

.2 NFPA 90B, Standard for the Installation of Warm Air Heating and Air Conditioning Systems (ANSI).

.6 Underwriters' Laboratories (UL) Inc.:

.1 UL 2021, Fixed and Location-Dedicated Electric Room Heaters.

1.5 Action and Informational Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical and Section 01 33 00 - Submittal Procedures for submission requirements.

.2 Product Data: Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish, and limitations.

.3 Submit copies of WHMIS MSDS - Material Safety Data Sheets in accordance with Section 02 81 01 - Hazardous Materials.

1.6 Closeout Submittals

.1 Refer to Section 21 05 01 - Common Work Results for Mechanical, Section 01 33 00 - Submittal Procedures, and Section 01 78 00 - Closeout Submittals" for submission requirements.

1.7 Delivery, Storage and Handling

.1 Shipping:

.1 All equipment, material and spare parts shall be shipped, stored, handled, and installed in such a manner as not to degrade quality, serviceability, or appearance. Equipment and material warranties shall not be voided by actions of the Construction Contractor.

.2 Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.

.3 Pack spare parts in containers bearing labels clearly designated contents and pieces of equipment for which intended.

.4 Deliver spare parts at same time as pertaining equipment. Deliver to the City after completion of Work.

.2 Receiving:

.1 All equipment, material and spare parts shall be delivered to the Site in original packages or containers bearing the manufacturer's labels and product identification.

.2 Inspect for damage and correctness, and inventory items, upon delivery to Site.

.3 Store equipment, material and spare parts protected for the weather, humidity and temperature variations, dirt and dust or other contaminants. Store and safeguard in accordance with Manufacturer's recommendations.

1.8 Quality Assurance

.1 Performance Requirements:

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

2. PRODUCTS

2.1 General

.1 Provide CSA approved, packaged factory assembled components.

2.2 Unit Heaters for Electrically Classified Areas

.1 Casing: 1.2 mm thick steel, epoxy coated finish with lugs for unit suspension. Adjustable louvers with directional vanes to direct air flow.

.2 Heating Coil:

.1 13 mm nominal diameter seamless, heresite coated, copper tubes and shall be mechanically expanded to provide an efficient, permanent bond between the tube and integral collar of the aluminum fin.

.2 Minimum copper tube thickness shall be 0.7 mm.

.3 Fins shall be die-formed and have a high efficiency aluminum surface optimized for heat transfer, air pressure drop and carryover.

.4 Minimum fin thickness shall be 0.25 mm.

.5 Lanced fins shall not be acceptable.

.6 Fins are continuous across width and depth of coil and are vertically oriented to resist collection of dirt and foreign particles.

.7 Coils are of non-ferrous construction and serpentine design or will incorporate brazed steel header tubes.

.8 All coils shall be tested at 1896 kPa air pressure under water, and rated for a maximum 1517 kPa water and 190°C.

.9 Coils have CRN pressure vessel certification.

.3 Motor: Explosion-proof. Thermally protected. Permanently lubricated ball bearings.

.4 Control circuit: 120 V.

.5 Disconnect switch: by Division 26.

.6 Control transformer: Built in factory installed.

.7 Contactor: Built in factory installed.

.8 Factory installed summer/winter switch.

.9 Stainless steel wall-mount hardware.

.10 Wall-mount remote-control thermostat.

2.3 Unit Heaters

.1 Casing: 1.31 mm thick galvanized steel, epoxy coated finish with lugs for unit suspension and hinged door accessed control panel.

.2 Heating Coil:

.1 13 mm nominal diameter seamless copper tubes and shall be mechanically expanded to provide an efficient, permanent bond between the tube and integral collar of the aluminum fin.

.2 Minimum copper tube thickness shall be 0.7 mm.

.3 Fins shall be die-formed and have a high efficiency aluminum surface optimized for heat transfer, air pressure drop and carryover.

.4 Minimum fin thickness shall be 0.25 mm.

.5 Lanced fins shall not be acceptable.

.6 Fins are continuous across width and depth of coil and are vertically oriented to resist collection of dirt and foreign particles.

.7 Coils are of non-ferrous construction and serpentine design or will incorporate brazed steel header tubes.

.8 No exposed copper. Provide protective coatings as required.

.9 All coils shall be tested at 1896 kPa air pressure under water, and rated for a maximum 1517 kPa water and 190°C.

.3 Coils have CRN pressure vessel certification.

.4 Fan: Direct drive propeller type, factory balanced, with aluminum alloy blades, steel hub and Occupational Safety & Health Administration approved fan guard.

.5 Motor: Totally enclosed, permanently lubricated ball bearings with thermal overload protection.

.6 Air outlet: Individually adjustable extruded aluminum directional vanes.

.7 Temperature hi-limit: Automatic reset.

.8 Fan-only switch: Built in factory installed.

.9 Contactor: Built in factory installed.

.10 Thermostat: Remote, shipped loose, located as per Drawings.

.11 Performance: As scheduled with 50% propylene glycol.

2.4 Cabinet Unit Heaters

.1 Casing:

.1 Steel, minimum 1.2 mm thickness, white polyester powder paint finish, bottom air outlet, high limit temperature control with automatic reset.

.2 Heating Coils:

.1 Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 2.1 mm, rated for a minimum working pressure of 2067 kPa and a maximum entering-water temperature of 104ºC. Minimum copper tube thickness shall be 0.4 mm. Minimum fin thickness shall be 0.11 mm. Lanced fins shall not be acceptable. Coils shall be circuited for counter flow to maximize unit efficiency. Coil casing shall be fabricated from galvanized steel. Include manual air vent and drain valve.

.3 Fan:

.1 Plate axial, closed, factory lubricated motor, 55 dbA @ 1 m in free field conditions at a flow rate of 75 l/s.

.4 Controls and Valves:

.1 All valves and controls factory installed.

.2 Remote thermostat to control fan and motorized valve.

.3 Control knob for three (3) fan speeds.

.4 Two-Piece Ball Valves: Forged brass body with full-port, chrome-plated brass ball; PTFE seats; and 4140 kPa minimum CWP rating and blowout-proof stem.

.5 Calibrated-Orifice Balancing Valves: Bronze body, ball type; 1376 kPa working pressure, 121ºC maximum operating temperature; with calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, threaded ends, and equipped with a memory stop to retain set position.

.6 Y-Pattern Hydronic Strainers: Forged brass body; 4140 kPa working pressure; with sweat connections and perforated stainless-steel basket.

.7 Forged Brass Unions: ASME B16.22.

.5 Performance: As scheduled with 50% propylene glycol.

3. EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Cleaning

.1 Remove surplus materials, excess materials, rubbish, tools, and equipment.

END OF SECTION

1. GENERAL

1.1 Related Sections

.1 Requirements specified within this section apply to all sections in Division 26, Electrical. This section supplements requirements of other Divisions.

1.2 Codes and Standards

.1 Manitoba Building Code (MBC).

.2 The Winnipeg Electrical By-law (WEB).

.3 CSA C22.1 Canadian Electrical Code - Part 1 (CEC).

.4 CSA C22.2 No. 0 General Requirements - Canadian Electrical Code - Part 2.

.5 CAN3-C235 Preferred Voltage Levels for AC Systems, 0-50,000 V.

.6 Electrical and Electronic Manufacturers Association of Canada (EEMAC).

.7 National Electrical Manufacturers Association (NEMA).

.8 Institute of the Electrical and Electronic Engineers (IEEE).

.9 Insulated Cable Engineers Association (ICEA).

.10 Canadian Standards Association (CSA).

.11 Underwriters Laboratories Canada (ULC).

.12 American National Standards Institute (ANSI).

.13 National Fire Protection Agency (NFPA).

.14 Comply with the most current locally enforced edition of CSA C22.1 Canadian Electrical Code - Part 1, Winnipeg Electrical By-law, Provincial Safety Electrical Authority Codes and Bulletins.

.15 Comply with all laws, ordinances, rules, regulations, codes, and orders of all Authorities Having Jurisdiction relating to this Work. Where these regulations conflict, comply with the most stringent condition.

.16 Comply with latest editions of the CSA Certification Standards and Bulletins.

1.3 Drawings and Specifications

.1 All materials, equipment, labor, work denoted on the Drawing set is to be considered as new work, to be provided by the Contractor unless specifically noted otherwise. Some of the electrical and automation Drawings show existing systems (with modifications to these systems). These Drawings specifically indicated that there are existing systems shown.

Where Drawings do not specifically indicate that existing systems are depicted, the Contractor shall assume that the materials, equipment, labor, work indicated will form part of his scope, and the Contractor shall include all costs (including materials, labor, etc.) to perform the work.

.2 Prior to installing power and control cabling for process equipment, the Contractor shall review the equipment Shop Drawings, and to ensure that cabling requirements are understood. There may be variations in wiring requirements with process and HVAC equipment, that may require alternate wiring requirements from that shown on the Drawings. Include such wiring and connections in tender at no additional costs.

.3 The electrical Drawings in some cases indicate the size of cables, breakers, conduits, etc. These sizes are based on the supply of specific sizes of equipment. For cases where the Contractor supplies equipment that varies from these assumptions it is the responsibility of the Contractor to provide the correct size of breaker, cable, etc. to suit the installation, at no additional cost to the Contract.

.4 The intent of the Drawings and Specifications is to indicate labor, products, and services necessary for a complete, installed, tested, commissioned and functional installation.

.5 Electrical Drawings may indicate approximate route to be followed by conduits and cables and general location of electrical equipment. They do not show all structural, architectural and mechanical details. In some cases, conduit or wiring is only shown diagrammatically on the Drawings. The details on exact cable or conduit routing, and exact equipment installation location is to be determined on site and coordinated with all other trades.

.6 Where circuit numbers are shown adjacent to equipment, the Electrical Contractor shall provide all wiring, conduit, supports, and any other requirements to provide power to that piece of equipment from the circuit indicated. Where circuit numbers are not shown adjacent to a piece of 575 V equipment, refer to the single line drawings for connections details. Provide all wiring, conduit, supports, and any other requirements to provide power to that piece of equipment.

.7 To provide sufficient detail and maximum degree of clarity on the Drawings, symbols used for various electrical devices, particularly wall mounted devices, take up more space on the Drawings than devices physically do. Locate devices with primary regard for convenience of operation, accessibility and space utilization, rather than locating devices to comply with the exact scaled locations of the electrical symbols.

.8 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 a Bid.

.9 Provide all minor items and work not shown or specified but which are reasonably necessary to complete the Work.

.10 Various package unit types of equipment are included in the work. It is the responsibility of the Contractor to familiarize themselves with the requirements of the equipment vendor, and to include all materials and labor for a complete and working installation. In some cases this means that motors, valves, actuators, etc. need to be wired and connected in the field. The Contractor shall include all costs to perform such services as part of his Tender submittal. Coordination between the equipment vendor and the Contractor shall be performed prior to

Tender bid closing date, and all costs shall be included in the tender. Request for extras due to lack of coordination between the Contractor and the equipment vendors will not be accepted.

.11 In some cases the plan Drawings indicate the symbol for 1 motor - for package units – when in reality, there are multiple motors, valves, dampers, solenoids, associated with the piece of equipment. It is the responsibility of the Contractor to understand the intricacies of the packaged equipment, and to perform all field connections for a complete and working system.

.12 In some cases motorized dampers are shown only with one symbol on the Drawings, when in fact multiple motorized dampers are required in order to accommodate the opening size and the actuators. In these cases it is the responsibility of the Contractor to wire and connect all required actuators to allow for correct operation of the system at no additional cost.

.13 Cables schedules / lists where shown do not include all cables required to perform the complete Facility installation. They shall be used as a general guide. Accurate cable lists, quantities, take-offs remain the responsibility of the Contractor. Cable schedules only show cabling where specific cable tags are available on the Drawings. Refer to the cable schedule for specific systems which are not included on the schedule, and include materials, and installation for all remaining cabling.

1.4 Care, Operation, and Start-Up

.1 Instruct the Contract Administrator’s maintenance and operating personnel in the operation, care and maintenance of systems, system equipment and components.

.2 Where services of a Manufacturer’s Factory Service Engineer is required, arrange and pay for services to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

.3 Provide factory service engineer support for such a period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are familiar and fully trained with all aspects of its care and operation.

1.5 Permits, Fees, and Inspection

.1 The Contract Administrator will submit to Electrical Inspection Department and Supply Authority necessary number of Drawings and Specifications for examination and approval prior to commencement of Work.

.2 The Contractor shall pay associated fees as required by the Electrical Inspections and Permitting department.

.3 Notify the Contract Administrator of changes required by Electrical Inspection Department prior to making changes.

.4 Furnish a Certificate of Final Inspection and approvals from inspection authority to the Contract Administrator.

1.6 Definitions

.1 The following are definitions used in Division 26.

.1 Inspection Authority means agent of any authority having jurisdiction over construction and safety standards associated with any part of electrical Site Work.

.2 Supply Authority or Supply Utility means electrical power company or commission responsible for delivering electrical power to the Project Site.

.3 Electrical Code or Code means the Electrical Code in force at the project location.

.4 CEC means Canadian Electrical Code (latest edition being enforced by law).

.5 Contractor and Electrical Contractor means the entity retained to perform the Work listed herein.

.6 Contract Administrator means the person with the authority to make decisions and administer the Contract on behalf of the City.

.7 Provide means to supply, install, wire, connect, test, commission and leave in complete and working order.

.8 The term “Shop Drawing” means Drawings, diagrams, illustrations, schedules, performance characteristics, brochures and other data, which are to be provided by the Contractor to illustrate details of a portion of the Work.

1.7 Design Requirements

.1 Design equipment, anchorage, and support systems for vertical and lateral loading in accordance with MBC.

.2 Operating voltages to be within those defined in CAN3-C235.

.3 Verify before energization that equipment supplied under this Contract is compatible with the site electrical power supply system.

.4 All equipment, devices and installation methods (even where not specifically expressed on the Drawings) shall comply with the Manitoba Energy Code for Buildings (MECB).

1.8 Electrical Coordination

.1 Coordinate Work with all other trades to ensure that conflicts do not occur.

.2 Coordinate requirement of mechanical equipment requiring electrical connection with the Mechanical Contractor. Pay specific attention to equipment full load amps, voltage, phase and breaker size.

.3 Verify that all equipment ordered is compliant with the Manitoba Energy Code for Buildings.

.4 Coordinate work with utilities where appropriate, including but not limited to:

.1 Incoming overhead lines,

.2 Underground buried services,

.3 Transformer(s) supplying main electrical service to the Facility,

.4 Installation of Supply Authority meter, and

.5 Installation of incoming telephone / data communication service conductors or cables.

1.9 Submittals

.1 Permits, Fees and Inspection:

.1 Furnish copies of all inspection reports and Certificate of Final Acceptance from Electrical Inspection Authority and any authorities having jurisdiction on completion of Work to Contract Administrator and include copies in the O & M manuals.

.2 Site Documentation:

.1 In each electrical room, provide power distribution system single line diagrams in glazed metal frames.

.2 Provide fire alarm riser diagram, plan and building zoning in glazed metal frame at fire alarm control panel and annunciator to meet requirements of Fire Commissioner.

.3 Where work includes modification to existing power distribution or fire alarm systems, provide new single line and riser diagrams showing complete modified system. Reinstall diagram into existing frames where feasible or provide new frame and glazing.

.3 Within fifteen (15) days of award of the Contract, the Contractor shall submit a completed equipment procurement schedule, which lists the Manufacturer and model of equipment, indicating the projected ordering, Shop Drawing submittal date and delivery dates of all products to meet the required construction schedule.

.4 Prior to delivery of any products to the job site and sufficiently in advance of requirements to allow ample time for checking, submit Shop Drawings for review as specified in Division 1.

.5 Submit Shop Drawings (including product data) for all equipment as required in each Section of this Specification.

.6 Prior to submitting the Shop Drawings to the Contract Administrator, the Contractor shall review, date and sign the Shop Drawings to determine that the equipment complies with the requirements of the Specifications and Drawings.

.7 Shop Drawings shall indicate materials, methods of construction and attachment of support, wiring diagrams, connections, recommended installation details, explanatory notes and other information necessary for completion of the Work. Where equipment is connected to other equipment, indicate that such items have been coordinated, regardless of the Section under which the adjacent items will be supplied and installed. Indicate cross-references to design Drawings and Specifications. Adjustments made on Shop Drawings by the Contract Administrator are not intended to change the Contract price. If adjustments affect the value

of the work, state so in writing to the Contract Administrator prior to proceeding with the work.

.8 Manufacture of products shall conform to the revised Shop Drawings. Failure to supply a product based on the revised, marked up Shop Drawings may require on site product revisions or modifications, which will be at the cost of the Contractor.

.9 Keep one (1) complete set of Shop Drawings at job Site during construction.

.10 Prior to shipping prefabricated control panels, photos of completed panels shall be sent to the Contract Administrator of final review. The resolution of the photos should be such that individual wire tags can be read.

.11 Shop Drawings shall have the specific equipment numbers on all pages to clearly indicate which piece of equipment the Shop Drawing refers to. In addition, the entire product part number or catalog number should be adjacent to the tag.

1.10 As-Built Drawings

.1 Refer to Section 01 78 00, Closeout Submittals - for additional requirements for As-Built Drawings.

.2 The Contractor shall keep one (1) complete set of white prints at the Site during work, including all addenda, change orders, site instructions, clarifications, and revisions for the purpose of As-Built Drawings. As the Work on-site proceeds, the Contractor shall clearly record in red pencil all as-built conditions, which deviate from the original Contract Documents. As-Built Drawings to include circuiting of all devices, conduit and feeder runs (complete with conductor size and number) and locations of all electrical equipment.

.3 On completion of the work, minimum of four (4) weeks prior to final inspection, submit As-Built Drawings to Contract Administrator for review. The Contractor shall certify, in writing signed and dated, that the As-Built drawings are complete and that they accurately indicate all electrical services, including exposed as well as concealed items.

.4 Print, frame, and mount all as-built single line drawings on size D sheet in the electrical room(s). For modifications to areas with existing electrical installations, replace the existing single line drawing with the latest As-Built.

.5 Comply with all other City of Winnipeg standards and requirements.

1.11 Operations and Maintenance (O&M) Manuals

.1 Provide operation and maintenance manuals as specified herein and in accordance with the general conditions. Refer to Section 01 78 23, Operations and Maintenance Data.

.2 Include in the operations and maintenance manuals a minimum of:

.1 Cover page including project name, year, name of owner and electrical consultant. Cover page shall be enclosed in a clear plastic cover.

.2 Index.

.3 List of manufacturers and supplier for all items.

.4 Names, address and phone number of all local suppliers for items included in maintenance manual.

.5 Stamped and signed Shop Drawings.

.6 Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of portions or features of the installation.

.7 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items and parts lists. Advertising or sales literature not acceptable.

.8 All test results performed. This includes, but is not limited to, fire alarm V.I report, grounding system tests, battery bank test results, genset tests, switchgear tests, operation tests, cable tests, MCC tests, load balancing tests, Hi Pot tests, Megger tests, factory tests of all major systems, etc. Submit test results on COW approved test sheets.

.9 Panel schedules (hardcopy and Microsoft Excel format).

.10 Software copies of relay settings

.11 As-Built drawings.

.12 Signed and dated warranty certificate.

.13 Signed and dated approval by the local Electrical Inspections Department.

.14 All other requirements outlined in the Specifications.

.3 Submit draft document prior to the start of Commissioning.

.4 Comply with all other COW standards and requirements.

1.12 Environmental Conditions

.1 Equipment and systems are to be rated to correctly operate in the environment in which they are to be installed.

.2 Exterior devices shall be rated to operate in an exterior environment with temperature range of -40°C to +40°C.

1.13 Quality Assurance

.1 Qualifications:

.1 For work involving specialties, including, but not limited to, the installation of high voltage switchgear, high voltage cables, overhead pole lines, sound and intercommunication systems, fire alarm systems, lightning protection systems,

equipment cathodic protection, grounding systems, instrumentation, controls, electronic access, security systems, fibre optics systems, etc. employ only workers fully trained, qualified and experienced in the aspects of such work.

2. PRODUCTS

2.1 Accepted Materials

.1 Materials: approved by and bearing a CSA label. Where there is no alternative to supplying equipment or material that is not approved or certified as indicated, obtain and pay for special approvals from the Office of the Fire Commissioner, Inspection and Technical Services Manitoba.

.2 Factory assemble control panels and component assemblies. Control panels to be CSA certified. Include current interrupting rating on the front panel. Shop Drawings for custom built control panels (which are not designed and sealed as part of the Issued for Construction documents) shall be signed and sealed by an engineer, registered in the Province of Manitoba.

.3 Minimum enclosure type to be NEMA 12 unless otherwise specified. Refer to the Drawings and other Specification section for specific requirements.

.4 Provide materials and equipment in accordance with Section 01 61 00, Common Product Requirements.

2.2 Equipment Finish

.1 Where on site finishing is required, prepare and prime surfaces as specified in Section 09 91 00, Painting.

.2 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two (2) coats of finish enamel.

.3 Paint indoor switchgear and distribution enclosures light grey to ANSI 61 grey enamel, unless otherwise specified.

2.3 Equipment Identification

.1 Identify electrical equipment with nameplates as described below.

.2 Nameplates:

.1 Lamacoid, 3 mm thick plastic nameplates, mechanically attached with self tapping stainless steel screws, white face with black lettering. Note: “Sheet Metal Screws” or other sharp pointed screws are NOT acceptable.

.2 Sizes as follows:

Table 2.1: Nameplate Sizes

Size	Dimension	Lines of Text	Text Height
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	40 x 90 mm	2 lines	8 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	5 mm high letters
Size 8	35 x 100 mm	3 lines	5 mm high letters
Size 9	45 x 100 mm	4 lines	5 mm high letters
Size 10	75 x 160 mm	3 or 4 lines	8 mm high letters
Size 11	150 x 250 mm	3 or 4 lines	10 mm high letters

.3 Wording on nameplates to be approved by Contract Administrator prior to manufacture.

.4 Allow for average of fifty (50) letters per nameplate.

.5 Identification to be in English and by tag.

.6 Provide nameplates for the following, sizes as shown:

.1 Power, voice and data receptacles – Size 1.

.2 Panelboards – Size 9.

.3 Dry Type Transformer – Size 10.

.4 Cabinets – Size 8.

.5 Small Junction Boxes (150mm x 150mm or smaller) – Size 1.

.6 Large Junction Boxes – Size 2.

.7 Control panels – Size 8.

.8 Contactors – Size 8.

.9 Terminal / splitter cabinets – Size 8.

.10 MCCs, switchgear, distribution equipment – Size 10.

.11 Each cell or bucket in an MCC – Size 7.

.12 Each breaker cell located within switchgear – Size 5.

.13 Motor starters – Size 8.

.14 Light Switches – Size 1.

.15 Emergency lighting battery banks – Size 7 or Size 8.

.16 Emergency lights – Size 1.

.17 Exit signs – Size 3.

.18 Disconnect switch – Size 8.

.19 Wall mounted fire alarm devices – Size 2.

.20 Ceiling mounted fire alarm devices – Size 4.

.21 Oil filled padmount transformers – Size 11.

2.4 Wiring Identification

.1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour code: to CSA C22.1.

.4 Use colour coded wires in communication cables, matched throughout system.

2.5 Conduit and Cable Identification

.1 Colour code conduits, boxes and cables.

.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 5 m intervals.

.3 Colours: 38 mm wide prime colour and 19 mm wide auxiliary colours.

Table 2.2: Conduit and Cable Colour Code

System	Prime Band	Aux. Band
Medium Voltage (>750 V)	Orange	
347/600 V	Yellow	
120/208/240 V Power	Black	
UPS 120/208/240 V Power	Black	Green
Control Wiring (120 V)	Black	Orange
Fire Alarm	Red	
Low Voltage Communication/General	Blue	
Low Voltage Control Wiring (<50 V)	Blue	Orange

System	Prime Band	Aux. Band
Intrinsically Safe	Blue	White
Ground	Green	
Fibre Optic	Purple	

.4 Cable Identification: Supply and install lamacoid type cable identification tags for all cables. Install identification tag at both ends.

3. EXECUTION

3.1 Preparation and Protection

.1 Schedule expediting of materials and execution of work in conjunction with associated work of other trades in order to meet the required work schedule.

.2 Post engraved warning signs to meet requirements of local bylaws, Inspection Authority and Contract Administrator.

.3 Protect those working on or in vicinity of exposed electrically energized equipment from physical danger. Shield and mark live parts in accordance with local regulations. Indicate the appropriate voltage.

.4 Arrange for installation of temporary doors, barriers and similar items for access to rooms and areas containing electrical equipment. Keep these doors locked at all times, except when under direct supervision.

.5 Permanently identify with lamacoid nameplate, equipment energized from multiple power sources, noting voltages, power source locations, supply disconnect designations and grounding electrode location.

3.2 Warning Signs

.1 As specified and to meet the requirements of Electrical Inspection Department and the Contract Administrator.

.2 Lamacoid 3 mm thick plastic engraving sheet, red face, white core, mechanically attached with self tapping screws, 20 mm text.

3.3 Mounting Heights

.1 Unless otherwise noted, or in contravention of codes and standards, mount equipment replacing existing equipment at the same height.

.2 Mounting height of equipment is from finished floor to centerline of equipment unless specified or indicated otherwise.

.3 If mounting height of equipment is not indicated, verify with the Contract Administrator before proceeding with the installation.

.4 Mount indoor electrical distribution equipment utilizing one of the following:

.1 Floor mount on 89 mm (3.5") concrete housekeeping pad

.2 Surface wall mount to concrete walls (inside electrical rooms).

.3 For areas of elevated humidity or moisture (or where a suitable wall is not available) – mount on modular metal support system: Unistrut, Cantruss, or similar.

.4 Surface wall mount on 19 mm (3/4") thick fire-retardant plywood backboard (for non structural type of walls and to provide a level of fire-retardant barrier where needed).

.5 Recess mount (as indicated on the Drawings).

.5 Install electrical equipment at the following heights unless indicated or directed otherwise (to bottom of the equipment):

.1 Outlets above counters: 150 mm (6"); splashbacks: 100 mm (4").

.2 General receptacles & communications outlets: 400 mm (16").

.3 Receptacles in mechanical and shop areas: 1 m (40").

.4 Switches, dimmers, push buttons: 1.2 m (48").

.5 Thermostats: 1.4 m (56").

.6 Security alarm bells, horns, speakers: 2.2 m (88").

.7 Motor starters: 1675 mm (66") to top.

.8 Panelboard: 2.0 m (78") to top.

.9 Control Panels: 1675 mm (66") to top.

.10 Clock outlets: 2.15 m (84").

.11 Emergency lighting battery bank unit: 2.1 m (82").

.12 Emergency light remote head: 150 mm (6") below ceiling, to a maximum height of 3.0 m (118").

.13 Wall mount Exit signs: 2.2 m (87") or higher as required to coordinate with door height.

.14 Pushbutton for power door assist: 900 mm (35.4").

.15 Intrusion alarm motion detectors: 150 mm (6") below ceiling, to a maximum height of 3.0 m (118").

.16 Intrusion alarm keypad: 1500 mm (59").

.17 Fire alarm panel: 1650 mm (65") to top.

.18 End of line resistors: 1.6 m (64”).

.19 Fire alarm pull stations: 1320 mm (52”).

.20 Fire alarm horn / strobe: a minimum of 150 mm (6”) below ceiling to the top edge of the device (for low ceiling areas). Where ceilings allow, mount devices at 2400 mm (94.5”) (measured to top of device) above finished floor.

.21 Coordinate and confirm elevations indicated on the Architectural Drawings. Where discrepancies occur, request clarification from the Contract Administrator.

.22 Mounting heights to meet all codes and regulations. Fire alarm devices to be in accordance with CAN / ULC-S524.

.23 Coordinate and confirm elevations indicated on the Architectural elevations. Where discrepancies occur, request clarification from the Contract Administrator.

3.4 Location of Devices

.1 Allow for change of location of devices at no extra cost or credit, provided that the distance does not exceed 3000 mm (10’) from that shown on the Drawings, when the requirement is made known prior to installation.

3.5 Conduit and Cable Installation

.1 Sleeves through concrete: schedule 40 galvanized steel pipe, sized for free passage of conduit.

.2 For wall, partitions, and ceilings the sleeve ends shall be flush with the finish on both sides but for floors they shall extend 25 mm (1”) above finished floor level.

.3 Fire stop opening with ULC approved assembly for the installation conditions.

.4 Provide a detailed proposed conduit routing plan to the Contract Administrator prior to proceeding with the installation of conduit.

.5 If possible, avoid routing conduits through hazardous area.

.6 Separate cables of different voltage levels when cables are installed parallel to each other.

3.6 Cutting, Patching, Drilling

.1 Provide all cutting and patching as required.

.2 Return exposed surfaces to an as-found condition.

.3 Exercise care where cutting/drilling holes in existing concrete elements so as not to damage existing reinforcing, or any other systems run in the concrete.

.1 Locate reinforcing and other existing systems using ground penetrating radar, X-Ray or other suitable means. Mark out on the surface of the concrete the locations of rebar and all other systems.

.2 For all holes larger than 50 mm passing through reinforced concrete, mark the location of the desired hole and all embedded systems. Obtain approval from the Contract Administrator prior to cutting.

.4 Firestop and seal all penetrations.

.5 Ensure that water ingress will not occur.

.6 Provide expansion joints for penetrations where shifting can occur.

3.7 Anchor Installation

.1 The Contractor shall exercise care where installing anchors into existing concrete elements so as not to damage existing reinforcing. All anchors shall be installed utilizing carbide tip drill bits. The existing reinforcing shall be located utilizing a reinforcing bar locator and marked out on the surface of the concrete. The drill holes shall be advanced to the required depth for installation of the anchors. Should reinforcement be encountered while drilling the hole shall be terminated and repositioned to clear the reinforcement. Do not use core bits that can easily intercept and damage/cut the reinforcing during drilling.

3.8 Field Quality Control

.1 All electrical work to be carried out by qualified, licensed electricians or apprentices as per the conditions of the Provincial Act respecting manpower vocational training and qualification. Employees registered in a provincial apprentices program shall be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks - the activities permitted shall be determined based on the level of training attained and the demonstration of ability to perform specific duties. A maximum of one (1) apprentice is permitted per qualified electrician.

.2 The Work of this Division to be carried out by a Contractor who holds a valid Master Electrical Contractor license as issued by the Province of Manitoba.

.3 Furnish Manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to Manufacturer's instructions.

3.9 Load Balance

.1 Drawings and Specifications indicate circuiting to electrical loads and distribution equipment.

.2 Balance electrical load between phases as closely as possible on switchboards, panelboards, motor control centers, and other equipment where balancing is required.

.3 When loads must be reconnected to different circuits to balance phase loads, maintain accurate record of changes made, and provide circuit panel directory that lists final circuit arrangement.

3.10 Tests

.1 Test and check electrical, instrumentation and control systems for correct operation and compliance with statutory and regulatory authority requirements.

.2 Perform tests in presence of Contract Administrator. Log, tabulate, sign and include testing and Commissioning results in the O & M manuals.

.3 Testing shall include, but not be limited to, the following:

.1 All items indicated in Section 26 08 05, Acceptance Testing and the testing and Commissioning requirements.

.2 Electrical power distribution systems.

.3 Wire and cable system.

.4 Lighting, emergency lighting, photocell, lighting controls and interlocks.

.5 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

.6 Communications, control and instrumentation.

.7 Fire alarm and intercom systems.

.8 Standby genset power systems.

.9 All other equipment and systems as indicated in the Drawings and Specifications.

.4 Refer to appropriate Specification sections for specific system or equipment tests.

.5 Supply instruments, meters, consumable parts (such as fuses) and equipment. Arrange for qualified personnel to conduct tests.

.6 In cooperation with mechanical trades, take clamp-on ammeter readings with motors operating at full load. Compare values against the equipment nameplate rating. Log, tabulate and include readings in Maintenance Data and Operating Instructions.

.7 Correct systems which fail any test, correct and re-do tests to ensure proper operation of the system.

3.11 Checkout and Start-Up

.1 Voltage Field Test:

.1 Refer to Section 26 08 05, Acceptance Testing as applicable.

.2 Check Supply Utility voltage at point of termination of supply conductors when installation is essentially complete and is in operation.

.3 Check voltage amplitude between phases, and phase to neutral for loaded and unloaded conditions.

.4 Check voltage drop on at all distribution panels and ensure that it is less than 2% in accordance with CEC requirements.

.5 Check voltage drop on equipment loads and ensure that total voltage drop from the service to the farthest device is less than 5% in accordance with the CEC. Adjust transformer taps, and upsize conductors as required to meet the CEC.

.6 Unbalance Corrections:

.1 Make written request to the Supply Utility to correct conditions if the service voltage unbalance exceeds 3%.

.2 Current Field Tests:

.1 Make line current check after supply utility has made final adjustments to supply voltage.

.2 Check current balance at the service demarcation point. Adjust loads to ensure that each phase is appropriately balanced.

.3 Check line current in each phase for each piece of equipment.

.4 If the phase current for a piece of equipment is above rated nameplate current, prepare Equipment Line Phase Current Report that identifies cause of problem and corrective action taken.

3.12 Touch-Up Painting

.1 Clean and touch-up surfaces of shop painted equipment scratched or marred during shipment or installation, to match original paint.

.2 Obtain necessary touch-up paint of original type and quality from equipment Manufacturer.

.3 Clean surfaces to be painted. Feather out edges of scratch marks. Make patch inconspicuous.

.4 Apply one (1) or more coats until damaged surface has been restored to original finish condition.

.5 Clean and prime exposed non galvanized hangers, racks and fastenings to prevent rusting.

.6 Do not paint nameplates, tags, CSA labels, warning plates and operating instructions. Observe field painting of electrical equipment or raceways. Labels shall be visible and legible after the equipment is installed.

3.13 Cleaning

.1 Clean construction debris and materials from enclosures, before final electrical tests. Vacuum the interior and exterior of enclosures to ensure all equipment is free from debris.

3.14 Provision for Future Expansion

.1 In each electrical room, space has been left unoccupied for future equipment as per the City of Winnipeg's Water and Waste Department's Electrical Design Guide. Leave such space clean. Install conduit, wiring and other work in such a manner that necessary connections

can be made in future without dismantling existing equipment, raceways or wiring. Consult with Contract Administrator whenever necessary.

3.15 Breaker and Relay Settings

.1 The Electrical Contractor shall field adjust and set breaker and relay settings for all breakers, relays, VFDs, etc. in accordance with settings provided by the Contract Administrator. Settings will be provided to the Electrical Contractor after the submission and acceptance of Shop Drawings. Shop Drawing information will be used by the Contract Administrator to calculate the appropriate settings.

3.16 Training

.1 Provide training of City personnel in all aspects of maintenance, operation, and functionality for all systems.

.2 Training shall be performed at the NEWPCC Facility in Winnipeg, Manitoba. Training shall involve both classroom style of training, as well as practical training with the equipment present.

END OF SECTION

WIRE AND BOX CONNECTORS (0-1000V)

1. GENERAL

1.1 Section Includes

.1 Materials and installation for wire and box connectors.

1.2 References

.1 Canadian Standards Association (CSA):

.1 CSA C22.2 No.18.3, Conduit, Tubing, and Cable Fittings, and Update No. 1.

.2 CSA C22.2 No.18.4, Hardware for the Support of Conduit, Tubing, and Cable.

.3 CSA C22.2 No.18.5, Positioning Devices.

.4 CSA-C22.2 No.18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.

.5 CSA C22.2 No.65, Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).

.2 National Electrical Manufacturers Association (NEMA):

.1 C119.4 Connectors for Use between Aluminum-to-Aluminum and Aluminum-to-Copper, and Copper-to-Copper.

.3 Electrical and Electronic Manufacturer's Association of Canada (EEMAC):

.1 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

1.3 Action and Informational Submittals

.1 Submit in accordance with Division 1 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for wire and box connectors and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Sustainable Design Submittals:

.1 Construction Waste Management:

.1 Submit project Waste Management Plan and Waste Reduction Workplan highlighting recycling and salvage requirements.

.2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.

1.4 Closeout Submittals

.1 Submit in accordance with Division 1 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for wire and box connectors for incorporation into manual.

1.5 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Division 1 - Common Product Requirements and with manufacturer's written instructions.

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

.3 Storage and Handling Requirements:

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

.2 Store and protect wire and box connectors from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

2. PRODUCTS

2.1 Materials

.1 Service and Power Feeder Cables:

.1 Compression type terminations for copper incoming power service cables. Utility approved compression type connectors at transformer, for installation by utility.

.2 Compression type terminations for all feeder connections.

.2 Splicing only to be performed inside of suitable rated boxes.

.1 General locations: Fixture type splicing connectors (Marette twist on) to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

.2 Wet Locations or Underground: Use CSA splice kits suitable for direct burial to ensure moisture seal.

.3 Clamps or connectors for armoured cable, aluminum sheathed cable, mineral insulated cable, flexible conduit, non-metallic sheathed cable as required to: CSA-C22.2 No.18.3, 18.4 and 18.5.

.1 Provide appropriate terminals or power distribution blocks.

.4 Bushing stud connectors to consist of:

.1 Connector body and stud clamp for stranded round copper conductors.

.2 Clamp for stranded round copper conductors.

.3 Stud clamp bolts.

.4 Bolts for copper conductors.

3. EXECUTION

3.1 Examination

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

.1 Inform General Contractor of unacceptable conditions immediately upon discovery.

.2 Proceed with installation only after unacceptable conditions have been remedied.

3.2 Installation

.1 Remove insulation carefully from ends of conductors and:

.1 For Compression Type:

.1 Install all compression terminations and connectors using purpose made mechanical tool.

.2 For aluminum compression terminations also apply conductive paste (i.e. zinc joint compound) to conductor ends prior to installation of conductors.

.2 For Fixture type splicing connectors (Marette twist on wire nut):

.1 Twist wires together, insert into insulating cap and tighten.

.2 Place a strip of electrical tape over the full circumference of the cap ensuring the gap between the cap and the wires is covered. Firmly press tape in place.

.3 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by Manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65. Installation shall pass tug test, and meet secureness tests in accordance to the manufacturers requirements and CSA.

.4 Install bushing stud connectors per manufacturers requirements, and in accordance with NEMA and EEMAC 1Y-2.

3.3 Cleaning

.1 Progress Cleaning: clean in accordance with Division 1 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Division 1 - Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling.

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

END OF SECTION

1. GENERAL

1.1 Description

.1 This Section of the Specifications forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

.2 Provide all wire and cable requirements for voltage systems 1000 V or less as indicated within this Section.

1.2 References, Codes, Standards

.1 American Society for Testing and Materials (ASTM):

.1 B3, Standard Specification for Soft or Annealed Copper Wire.

.2 B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

.2 Canadian Standards Association (CSA):

.1 CSA C22.1, Canadian Electrical Code (CEC), Part 1), Safety Standard for Electrical Installations.

.2 CSA C22.2 No. 0.3, Test Methods for Electrical Wires and Cables.

.3 CSA C22.2 No. 18.3, Conduit, Tubing, and Cable fittings.

.4 CSA C22.2 No. 38, Thermoset-Insulated Wires and Cables.

.5 CSA C22.2 No. 49, Flexible Cords and Cables.

.6 CSA C22.2 No. 51, Armoured Cables.

.7 CSA C22.2 No. 65, Wire connectors.

.8 CSA C22.2 No. 123, Metal sheathed cables.

.9 CSA C22.2 No. 131, Type TECK 90 Cable.

.10 CSA C22.2 No. 174, Cable and cable glands for use in hazardous locations.

.11 CSA C22.2 No. 188, Splicing wire connectors.

.12 CSA C22.2 No. 197, PVC Insulating Tape.

.13 CSA C22.2 No. 208, Fire Alarm and Signal Control.

.14 CSA C22.2 No. 230, Tray Cables.

.15 CSA C22.2 No. 239, Control and Instrumentation Cables.

.3 Insulated Cable Engineers Association (ICEA) requirements where permissible.

.4 Institute of Electrical and Electronics Engineers (IEEE):

.1 383, IEEE Standard for Qualifying Electric Cables and Splices for Nuclear Facilities.

.2 1682, IEEE Standard for Qualifying Fiber Optic Cables, Connections, and Optical Fiber Splices for Use in Safety Systems in Nuclear Power Generating Stations.

.5 Underwriters Laboratories (UL):

.1 514B, Standard for Conduit, Tubing, and Cable Fittings.

1.3 Definitions

.1 Conductor: the current carrying portion of an insulated wire or an uninsulated wire. All conductors shall be stranded copper.

.2 Wire: a single, insulated conductor.

.3 Cables: an assembly of a single or multiple insulated conductors, with overall sheaths or jackets, with or without metallic armour or shielding.

.4 Wiring: describes wires, cables and conduit in a general way.

1.4 Submittals for Review

.1 Submit product data in accordance with Division 1 and Division 26.

.1 Catalogue and technical data.

.2 Installation data including allowable pulling tension, pulling radius, and bending radius.

.2 Submit Cable Schedule when indicated on the drawings or other specifications.

1.5 Shipment, Protection and Storage

.1 Ship, protect and store equipment as required by Division 26.

2. PRODUCTS

2.1 General

.1 Where manufacturer or series is specified, these are provided for the purpose of establishing the grade of quality for the materials specified in this section and are taken from one (1) manufacturer's product line. Unless otherwise noted, products from other listed manufacturers which have identical features and characteristics are acceptable.

.2 Refer to the other Division 26 specifications for acceptable cable and wire connectors.

.3 To prevent corrosion due in Hazardous locations that can have Group IIB gases present (i.e. H_2S), steel armor, steel conduit, and steel cable supports are generally not permitted. Utilize aluminum materials to prevent corrosion.

.4 All conductors (including grounds and bonds) to be high conductivity copper.

.5 Materials to be manufactured to Canadian CSA standards, approved and suitable for -40°C to +90°C operation. Wires and cables shall meet their applicable CSA standard for construction and for testing.

.6 Increase conductor sizes to account for loading, cable and conductor spacing with the associated de-rating factors, voltage drop, ambient temperature, equipment termination temperature ratings, and all other requirements in accordance with CEC requirements.

.1 Space out conductors and separate different systems and voltages in accordance with the CEC and the City of Winnipeg requirements.

.7 Outdoor applications: Manufacturer literature shall include sunlight resistant, and suitability for direct burial.

.8 Acceptable Cable Manufacturer: Nexans, General Cable, Southwire.

2.2 Fastenings and Supports

.1 Design wire and cable anchorage and support system for vertical and lateral loading in accordance with the Manitoba Building Code (MBC).

.2 One whole malleable iron, steel, aluminum, zinc straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.

.3 Channel type or cable tray supports for two (2) or more cables.

.4 Threaded rods: minimum 6 mm diameter to support suspended channels, increase size as required for the loads.

2.3 Wire Insulation Voltage

.1 The minimum wire insulation ratings as provided below is in general, and pending the mean and methods employed as part of the installation work. For example, barriers will be required in cable tray where insulation ratings are not the same, between power and control cabling systems, or between noisy cabling systems.

.1 Wiring at 50 V and less shall be a minimum of 300 V insulated.

.2 Wiring at 300 V and less shall be a minimum of 600 V insulated.

.3 Wiring at greater than 300 V:

.1 Shall be a minimum of 1000 V insulated when feeding equipment that can branch to multiple loads. Feed cabling to services, MCC's, distribution panelboards, distribution transformers etc. are generally 1000 V rated.

.2 Between a 600 V VFD and motor shall be a minimum of 2500 V insulated, and VFD/inverter rated.

.3 Shall be a minimum of 600 V insulated otherwise.

.2 Composite 600 V power and 120 V control cables will not be permitted on this project.

2.4 Insulated Ground Conductors

.1 Insulated copper ground conductors:

.1 Size: as indicated on the Drawings, but in no case smaller than CEC required sizes.

.2 Type: soft drawn, stranded, flexible, high conductivity.

.1 Use tinned-coated in corrosive/hazardous environments including when buried in earth, or embedded in concrete.

.3 Shall meet the requirements of ASTM B8.

.4 Insulation: chemically cross-linked thermosetting polyethylene (XLPE) material, rated RWU90

.5 Flame Test Rating:

.1 CSA FT4 (if exposed).

.2 CSA FT1 (if entirely within conduit).

.6 Insulation voltage rating: 600 V.

.7 Colour: green or green with yellow stripes as indicated on the Drawings.

2.5 Bare Ground Conductors

.1 Bare copper ground conductors:

.1 Size: as indicated on the Drawings, but in no case smaller than CEC required sizes.

.2 Type: soft drawn, stranded, flexible, high conductivity.

.1 Use tinned-coated in corrosive/hazardous environments including when buried in earth, or embedded in concrete.

.3 Shall meet the requirements of ASTM B8.

.2 Refer to the drawings and other grounding specifications for additional application and other requirements.

2.6 Building Wires

.1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.

.2 Copper conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE. RWU90 XLPE for grounding pigtails.

.3 Wires sized 2 AWG and smaller to be factory colour coded, taping will not be accepted.

2.7 Single Conductor Wire(s) in Conduit

.1 Insulation chemically cross-linked, thermosetting polyethylene, and, unless otherwise specified, rated RWU90, 1000 V. Use RWU90 insulation where specified, or in conduit systems in wet locations including below grade.

.2 Ensure conduit is dry and clean prior to pulling conductors in. If moisture is present, thoroughly dry and clean conduits.

.3 Use pulling lubricant when pulling conductors in conduit to reduce the strain on the wires. Lubricants must be polymer based and must not adversely affect or degrade cable insulation.

.4 Do not combine conductors in a common duct or conduit without regard for de-rating.

.5 Conductors, unless otherwise shown or specified:

.1 Stranded copper.

.2 Minimum size No. 12 AWG, for control signals No. 14 AWG may be provided.

.6 Colour coding and labeling per Division 26 requirements; wires sized No. 2 AWG and smaller to be factory-coded, taping will not be accepted.

2.8 Teck 90 Cable

.1 Cable and Colour Coding in accordance with Division 26 - Common Work Results for Electrical.

.1 Conductors and insulation same as for Building Wires, except that manufacturer's standard insulation colour coding for multi-conductor cabling is acceptable.

.2 Shall be installed in industrial, hazardous, underground, or wet areas and where noted on the Drawings and cable schedules.

.3 Where surface mounted, cables shall be securely supported using aluminum cable clamps and cabling support systems. Space supports a maximum of 1 m apart.

.4 Where multiple cables are run into an area, install cables on cable tray or on cabling support hangers.

.5 Cable consists of multi-conductor, composite, or single-conductor construction as shown on the drawings or as specified, plus grounding conductor, with interlocking aluminum armour and outer jacket.

.1 Outer jacket of thermoplastic polyvinyl chloride (PVC) material with low gas emissions, rated minus (-) 40°C, with flame test rating as required by building code.

.2 FT4 flame test requirements when installed in buildings of non-combustible and combustible construction. Refer to CEC Rule 2-130 and the National Building Code of Canada Article 3.6.4.3 for further information and requirements.

.3 FT6 flame test requirements when installed in spaces between a ceiling and floor, or ceiling and roof, that may be used as a plenum in buildings of combustible or non-combustible construction. Refer to CEC Rule 2-130 and the National Building Code of Canada Article 3.6.4.3 for further information and requirements.

.6 Minimum bend radius is 12 times, or larger as required by the cable Manufacturer.

.7 Hazardous Locations: Cable shall come with “HL” rating for hazardous locations in Zone 1 or Zone 2 areas.

.8 Conductors:

.1 Inner jacket thermosetting polyvinyl chloride (PVC) compound.

.2 Grounding conductor: copper

.3 Circuit conductors: copper, size as indicated.

.9 Insulation:

.1 Outer jacket: chemically Cross-linked polyethylene XLPE type RW90.

.2 Inner jacket: polyvinyl chloride (PVC), 600V or 1000V (as applicable), 100% insulation level.

.3 Voltage Rating: as required for the application/installation.

.10 Avoid damaging outer jacket covering the armor. In some areas, such as the chemical building, exposed armor is not desirable. Replace cables at no additional cost where outer jacket is damaged.

2.9 VFD Cable (Drive Rated Cable)

.1 A PVC outer jacket rated CSA C22.2 No. 0.3 FT4 and AG14 to ensure the cable is grounded at the terminations only, preventing the pick-up of stray currents. The black PVC jacket shall be UV resistant, suitable for outdoor use, and “HL” rated where required.

.2 Connector: Low impedance rated connector, refer to the connectors section within this specification for additional requirements.

.3 Conductors:

.1 Three (3) copper-conductors cable with three symmetrically positioned bonding conductors, size as shown or specified.

.2 Grounding conductors: Three soft bare copper, symmetrically located in continuous contact with the copper tape shield or continuous aluminum armour.

.3 Circuit conductors: copper, size as indicated.

.4 Armoured cable type:

.1 The continuously corrugated, corrosion-resistant aluminum sheath with 100% coverage and low resistance path to ground.

.1 Designed to reduce high frequency noise interference with data and control signals.

.2 Cross-linked polyethylene (XLPE) RW90 insulation on main conductors which guarantees high dielectric strength to withstand high voltage spikes of 2 to 3 times normal voltage. Longer cabling systems will require higher withstand capacities.

.3 Shield: Continuous copper tape shield with 50% overlap or continuous (non-interlocked) aluminum armour.

.4 Approved for six-pulse VFD use.

.5 Non-Armoured cable type:

.1 Conductors:

.1 Grounding conductors: Three soft bare copper, symmetrically located in continuous contact with the copper tape shield or continuous aluminum armour.

.2 Circuit conductors: copper, size as indicated.

.2 Cable for VFD application:

.1 Designed to reduce high frequency noise interference with data and control signals.

.2 Three bonding conductors – soft bare copper.

.3 Cross-linked polyethylene (XLPE), RW90 insulation on main conductors.

.4 Overall PVC outer jacket rated FT4.

.5 Shield: Continuous copper tape shield with minimum 50% overlap.

.6 Approved for six-pulse VFD use.

.3 All non-armoured VFD cables shall be run in conduit.

.6 Acceptable Manufacturers: Nexans DriveRx, Lapp Olflex, Belden VFD, or approved equal in accordance with the tender documents.

2.10 Instrumentation and Control Cables

.1 Armoured Control and Instrumentation Cable (ACIC) and Control and Instrumentation Cable (CIC) to: CAN/CSA-C22.2 No. 239.

.1 Armoured control and instrumentation cable (ACIC), to have aluminum, interlocked armour with overall PVC jacket. ACIC cable may be installed in cable tray, provided that:

.1 The cable tray does not contain power cables or at the very least a tray-rated barrier has been installed providing physical separation. When tray-rated barriers have been installed maintain separation between power and instrument/control systems.

.2 The ACIC cable voltage rating is equal to or greater than the highest voltage contained in the cable tray.

.2 Install Instrumentation Cable (CIC) in conduit, this cable may not be installed in cable tray. Protection in conduit is required over the entire length.

.2 Conductors: minimum size, #16 AWG, stranded, annealed (7 strand minimum), tinned copper, unless otherwise specifically noted on the Drawings.

.3 Insulation: chemically cross-linked thermosetting polyethylene (XLPE), rated type RW90, 300V.

.4 Conductor identification: Each grouping (pair, triplet, quad) by consecutive number coding, permanently marked at regular intervals.

.5 Construction: twisted pair, triplet, and quad grouping with staggered lay.

.6 Shielding shall be in conformance with:

.1 Minimum 100% coverage aluminum foil or mylar tape shield with minimum 25% overlap.

.2 Separate drain wire, minimum size 18 AWG, bare, stranded tinned copper. Drain wire to be in direct, continuous contact with the shield.

.3 One or more twisted shielded pairs as indicated.

.4 Shield drain wires, at the ungrounded end, are to be taped back to the cable. Do not cut the shield drain wire off.

.7 Jacket: PVC (-40 °C to +90 °C), low acid gas, minimum FT4 rated flame spread.

.8 Termination fittings: Type, configuration and gender required to connect cable directly to equipment without additional adapters or fittings.

2.11 Fire Alarm Cables

.1 Refer to the drawings and fire alarm specifications for additional requirements.

.2 Low energy, 300 V, FAS 105 shielded cable: minimum #16AWG, with PVC insulation.

.3 Overall aluminum /polyester foil shield, with tinned copper drain wire.

.1 Shields to be grounded at one end only (source end).

.4 All fire alarm cables shall be installed in a separate, dedicated conduit system.

.1 Install conductors to be entirely independent of all other wiring. Do not enter raceway, boxes or enclosures occupied by other wiring except where necessary to connect to power supply, communication circuit, or ancillary devices.

.5 For data communication link A (DCLA) fire alarm circuits, install primary wiring circuit and alternate wiring circuit in separate conduit having a minimum separation of:

.1 300 mm when installed vertically.

.2 1200 mm when installed horizontally.

.6 For data communication link A (DCLA) fire alarm circuits, the primary wiring circuit and alternate wiring circuit may share the same conduit:

.1 For a distance of less than 3000 mm where the primary and return conductors enter or exit field devices, control unit or transponder enclosures.

.2 For single conduit drops to individual field devices.

.3 For single conduit drops to multiple field devices installed in a single room not exceeding 100 m².

2.12 Flexible and Portable Cables

.1 Designations and Compliance:

.1 Flexible Cords; Type SOW, to CSA C22.2 No. 49, Type ST, to CSA C22.2 No. 49.

.2 Portable Cables up to No. 2 AWG, Type SGOW, to CSA C22.2 No. 96.

.3 Portable Power Cables up to 500 kcmil, Type G, to ICEA S-68-516.

.2 Type SOOW, flexible, extra hard usage conductor, watertight, rubber EPDM insulation, with CPE oil resistant outer covering and incorporated ground conductor, 90°C rated.

.3 Flexible, non-armored cables to be installed where plug / cord assemblies are specified and required.

.4 Flexible festoon cables to be installed where specifically required for mobile equipment. Terminate both ends of festoon cables, providing cable strain relief.

.5 Instrumentation and control flexible cables, to have braided flexible shield, minimum size 16 AWG.

.6 Conductors and Insulation:

.1 Stranded.

.2 Size as shown or specified.

.3 Insulation and conductor arrangement as determined by governing standard.

2.13 Mineral Insulated Cables

.1 Install cable securely supported by straps and hangers.

.2 Support 2-hour fire rated cable a minimum of every 1-meter interval (or less).

.3 Make cable terminations by using cable Facility approved termination kits. Termination must be performed by personnel specifically trained by the equipment Facility.

2.14 Ethernet and Fiber Cables

.1 Cable and Colour Coding in accordance with Division 26 - Common Work Results for Electrical.

.2 Minimum bend radius is 15 times, or larger as required by the cable Manufacturer.

.3 Cable consists of multi-pair or single-pair as shown on the drawings or specified, with interlocking aluminum armour and outer jacket.

.1 Ethernet cabling: Shielded twisted-pair with a minimum speed of Category 6 (CAT6).

.2 Fiber optic cabling - Indoor: with a minimum speed of OM3.

.4 Refer to Teck 90 Cable (Part 2.5 of this specification) for:

.1 Voltage Rating.

.2 Flame Test Rating.

.3 Hazardous Locations.

.4 Outer jacket.

2.15 Connectors for Armored Cables

.1 All metal-clad cable fittings, for jacketed and non-jacketed interlocked armour cable, shall incorporate an easily removable armour stop (not requiring fitting disassembly) ensuring proper positioning of the cable armour during cable termination.

.2 All connectors be watertight, approved for TECK cable. All connectors shall be packed with Liquid-type sealing compound (includes pouch of sealing compound with integral spout and fiber damming material. Putty-type sealing compound may also be used except for shielded cable applications. Watertight type shall include:

.1 An elastomeric bevelled bushing.

.2 A funnel entry, splined gland nut.

.3 A non-magnetic, stainless steel grounding device with dual grounding action.

.4 A taper threaded hub.

.5 A hexagonal body and gland nut.

.3 Integral seal type with metal-to-metal contact construction.

.4 Sealing of multi-conductor cable shall be accomplished with a liquid-type polyurethane compound.

.5 VFD requirements:

.1 Applies to all cabling in between the VFD and motor.

.2 A low impedance rated connector, with ratings required for the environment it is installed. Two tests shall be performed to demonstrate low impedance, mainly:

.1 The fitting is installed on the cable and screwed into an enclosure, then the resistance between the cable armor and enclosure is measured, the result can be no more than 50 mV. Refer to UL514B for typical testing setup.

.2 A pull test is then conducted and the test above is repeated a second time.

.6 Wet and Ordinary location: Regular TECK connector.

.7 Corrosive location: TECK Connector made of chemically resistive materials, or sealed and covered with Thomas & Betts (ABB) Shrink-Kon, heavy wall, heat-shrinkable protective tubing.

.8 Hazardous Locations:

.1 Provide an environmental seal around the outer jacket of the cable and electrically bond the fitting to the cable armour prior to potting the explosion-proof seal.

.2 Allow the possibility of disconnection without disturbing the environmental seal, the electrical bonding, or the explosion proof seal.

.3 Includes hazardous ratings sufficient for the Zone for which it is installed. TECK Connector made of chemically resistive materials, or sealed and covered with Thomas & Betts (ABB) Shirnk-Kon, heavy wall, heat-shrinkable protective tubing.

.9 Approved products:

.1 Teck Cable, (Non-Hazardous Locations):

.1 Approved Manufacturers: ABB (Thomas & Betts) or Eaton (Cooper Crouse-Hinds).

.2 Thomas & Betts Star® Teck ST series, aluminum.

.2 Teck Cable, (Hazardous Locations):

.1 Shall meet the requirements of CSA C22.2 No. 174 and be marked accordingly.

.2 Approved Manufacturers: ABB (Thomas & Betts) or Eaton (Cooper Crouse-Hinds).

.1 Thomas & Betts, Star® Teck XP (STX) series, explosion proof aluminum, CSA certified Class I, Divisions 1 and 2, Groups A, B, C, D.

2.16 Strain Relief Connectors

.1 Watertight type for use with flexible cables.

.2 Material compatible with connecting body such as junction, outlet or splice box to which connection is made.

.3 Stainless steel wire mesh cord grip where connector is used with free-hanging cable.

.4 Typical Products: Thomas & Betts Type RANGER.

2.17 Wire Connectors

.1 The following listings specify products for copper conductors only. Aluminum conductors are not foreseen for this project. In the event that aluminum conductors are specifically approved by the Contract Administrator, it is the Contractor's responsibility to select the appropriate connector, using the following specifications as the guideline.

.2 Twist-On Connectors:

.1 Insulated serrated or wing-type cap.

.2 Internal spiral spring; set-screw or crimp-type not acceptable.

.3 Minimum rating 600 V.

.4 Limited for use up to No. 10 AWG wire.

.3 Terminal Connectors:

.1 Ring-type or locking fork-type, crimp-on terminal with nylon insulating sleeve over brazed seam shank.

.2 Minimum rating 600 V, 105°C.

.3 Conductive member made from electro tin-plated copper.

.4 Use limited for conductors up to No. 10 AWG.

.4 Compression Lugs:

.1 Made from one-piece pure electrolytic copper tubing, tin plated.

.2 Colour coded or marked with manufacturer's die index.

.3 Long barrel for minimum two (2) crimps.

.4 For use with conductors No. 8 AWG and larger.

.5 For No. 1/0 AWG and larger conductors, use two-hole long barrel compression lugs wherever possible.

.6 Install ferrules with nylon insulating sleeves on all No. 14 AWG and smaller stranded wires being terminated on terminal strips. Individual ferrule is required for each conductor.

.5 Compression splices: similar to compression lugs, suitable for in-line, C-tap and similar configurations.

2.18 Joint Compound

.1 Conductive compound, suitable for application to threaded and compression connections.

.2 Compatible with cable and conductor insulation and material.

.3 Capable of being brushed on at temperatures from minus (-) 25°C to (+) 110°C.

.4 Typical products, within the limitations outlined:

.1 Aluma-Shield.

.2 Burndy Penetrox.

.3 Thomas & Betts Kopr-Shield.

2.19 Electrical Tape

.1 To be compatible with conductor or cable insulation or jacketing, as applicable.

.2 For general purpose (indoors): vinyl plastic (PVC insulating), premium grade, minimum 0.18 mm (7 mil) thickness, black or colour coded, as required. The tape is intended to be applied in layers, each layer being half-lapped. Typical product: 3M Super 33+ or 35.

.1 Where tape is used for identification of conductors at a supply connection point or similar location, “Weather Resistance” tape shall be used.

.3 Self-vulcanizing linerless rubber tape, minimum 0.76 mm (30 mil) thickness. Typical product: 3M Type 130 C.

3. EXECUTION

3.1 Coordination

.1 Provide adequate notice to the Contract Administrator so that all cable installations can be inspected prior to connecting equipment.

.2 Coordinate with Division 26 – Electrical System Studies.

.1 Provide complete run lengths for all power cables from Equipment “A” to Equipment “B”, and a copy to the Contract Administrator for their records. For each cable run indicate the type of installation method (i.e., cable tray (& spacing), strut hangers, conduit (& type), underground etc.)

.1 Provide cable type (i.e. RW90, Teck90, THWN etc.)

.2 Provide Conductor type (i.e.. Alumimum or Copper).

.3 Provide Number of Conductors in cable, and size of conductors.

.4 Provide Number of Conductors per phase.

3.2 Field Quality Control

.1 Perform tests in accordance with Division 26 - Common Work Results for Electrical.

.2 Perform testing before energizing electrical systems.

.3 Perform megohmmeter testing of all cables (each conductor) for cable sizes 10 AWG and larger - with the following exceptions - megohmmeter testing is not required for: lighting circuit, 120 VAC duplex receptacle cabling. Provide test documentation for all cables tested.

3.3 General Cable Installation

.1 Lay cable in cable trays in accordance with Division 26 - Cable Trays for Electrical Systems.

.2 Terminate cables in accordance with Division 26 - Wire and Box Connectors - (0-1000 V).

.3 Re-use of existing wiring:

.1 Except where specifically identified or approved, reuse of existing wiring is not permitted.

.2 Ensure all existing wiring is tagged prior to disconnection of equipment.

.3 Tag spare wires as “Spare” and indicate the location of the other end of the wire. In addition, correlate / identify both ends of each conductor.

.4 Establish exact location of equipment and their connection points before wiring installation is commenced.

.5 Provide non-ferrous GPO (glastic) or aluminum plates for single conductor cable entry into an enclosure. Aluminum entry plate shall be used where conductor armour is required to be bonded to the enclosure. GPO (glastic) materials shall be used where cable armour is not bonded to the enclosure.

.6 In some cases, the electrical conductor size may be too big to terminate on vendor supplied lugs. In these cases, the Contractor remains responsible for making all cable terminations. The Contractor shall replace the lugs or shall provide reducing compression connectors to make the termination. Alternatively, the Contractor may provide appropriate junction boxes to reduce the conductors’ sizes as required to perform the cable termination.

.7 Do not embed cables or conduits in masonry or concrete without written approval from the Contract Administrator. Wiring through conduit sleeves for short, direct wall or floor penetration is accepted.

.8 Protect wiring against damage from welding spatter and other construction activity by suitable means.

.9 Protect metallic cable connectors in process areas with heat-shrinkage sleeves. Sleeve length to extend 75 mm past the connector and to provide a tight fit around connector and cable.

.10 Arrange wiring in process area such that motor connection boxes and other field mounted devices are entered at the side or bottom of the connection box or enclosure.

.11 Install reducing bushings where threaded entry in a motor connection box is larger than the hub size of the cable connector.

.12 Install wires and cables in a continuous length between termination points. Splices are not permitted, except within junction boxes or where specifically approved by the Contract Administrator. Where splices are necessary and approved utilize the cable Manufacturer approved and recommended kit. In-line splices are not acceptable.

.13 At the discretion of the Contract Administrator damage to a cable jacket may be repaired in accordance with the manufacturer's recommendation. If requested by Contract Administrator, replace the entire length of a damaged cable.

.14 Arrange cable supports such that maintenance work or removal of the equipment served by the cable, will not cause any damage to the cable.

.15 Fire stop completed conduit and cable penetrations at fire rated walls with approved materials.

.16 Provide an approved hazardous location barrier to maintain the hazardous location classification, at the location the conduit or cable penetrates the hazardous location boundary.

.17 Do not pull conductors into conduit or cable tray until rough building construction operations have been completed.

.18 Conduits and cable supports are only to support conduits or cables. Contractor shall not attach pipes, fixtures, and the like to conduit or cable supports.

.19 Conductor length for parallel feeders to be identical.

.20 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.

.21 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.

.22 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common/shared neutrals are not permitted.

.23 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

.24 Utilize weatherproofing sealing system appropriate for the area of installation. Install to the manufacturer's recommendations, flush with the exterior of the wall.

.1 Prior to covering up wall penetration work, arrange for a site inspection of the work with the Contract Administrator. Proof of proper installation is required.

.25 For outdoor or exposed installations, make all entries of cables or wires to equipment or panel from the bottom or side to minimize water entry points. Make no entries of cables or wires from the top unless specifically approved by the Contract Administrator.

3.4 Installation of Building Wires

.1 Install wiring as follows:

.1 In conduit systems in accordance with Division 26 - Conduits, Conduit Fastenings and Conduit Fittings, and as indicated on the Drawings.

3.5 Installation of Jacketed Armoured Cable (TECK, VFD rated etc.)

.1 Install on surface. One or two surface mounted cables may be strapped using one-hole aluminum straps with clamp back (Thomas & Betts 1275AL series or equal). Fastening, strapping and support materials shall be compatible with the area conditions. Strap at every 1 m intervals. Cables shall not be strapped to handrails and piping wherever possible.

.2 A group of three (3) or more cables running parallel to each other shall be installed in a cable tray.

.3 Install cable connectors at both ends of each armoured cable.

.4 Provide protection for cables where subject to mechanical damage, notably where cable passes through a floor slab.

.5 Tighten and mark Teck connector gland nuts following tightening. Mark shall be made with felt pen as a line between gland nut surface and surface of connector body to show relative position of gland nut after final tightening has been done.

.6 Where hazardous rated Teck connectors are used, installer shall follow manufacturer's assembly procedures for all stages of the installation. Allow cable sealing compound to harden in connector bodies before inserting connector and wires into connector hub.

.7 Group cables wherever possible on channels.

.8 Installation of VFD cables:

.1 VFD cable to be installed between a variable frequency drive (VFD) and the load which it serves.

.2 Secure using aluminum cable clamps.

.3 Route armored cable on cable tray or strapped to cabling system supports (for short runs only).

.4 Non-armored VFD cable is to be run in conduit.

.5 Metallic armor to be bonded to ground at both ends.

.6 Supply end of the VFD cable to have the bond conductors connected to the VFD drive and connected to ground. Load end of cables to have the bond conductors connected to the motor bond/ground lug.

.7 Wire and connect in accordance with the Facility's recommendations.

.8 Space VFD cable as per the following minimum distances:

.1 From 120/208 V wiring: 300 mm.

.2 From 24 VDC instrumentation and control wiring: 300 mm.

.9 Avoid damaging outer jacket covering the armor. In some areas, such as the chemical building, exposed armor is not desirable. Replace cables at no additional cost where outer jacket is damaged.

.9 In conduit systems in accordance with Division 26 - Conduits, Conduit Fastenings and Conduit Fittings, and as indicated on the Drawings.

.10 In cable tray systems in accordance with Division 26 – Conduits - Conduit Fastenings and Conduit Fittings, and as indicated on the Drawings.

.11 Install cable exposed, securely supported by straps/clamps, secured in spacing intervals as required by the code.

3.6 Installation of Control Cables

.1 Install control cables in conduit, cable troughs, or by direct burial as indicated on the Drawings.

.2 Ground control cable shield.

3.7 Installation of Flexible Cables

.1 Must be installed with strain relief-type connectors to take the tension from the cable termination.

.2 Provide wire mesh grip where cable is free hanging or subject to frequent flexing.

.3 Where excess cabling is to be provided, neatly coil and tie excess length and attach to structure using hooks or supports as specified.

3.8 Connector Sizing

.1 Strictly adhere to manufacturer's listing for matching connector and terminal sizes to cable and conductor sizes.

.2 Similarly, the proper compression tools and dies must be selected for each compression fitting to obtain the correct compression strength and as not to damage insulation sleeves and finishes.

.3 Select cable connectors with correctly sized grommets, bushings, glanding devices and threads. The application of tape or using reducers is not an acceptable alternative to selecting the correct size connector.

3.9 Terminations and Splices

.1 Use locking fork-type connectors on flat screw-type terminals.

.2 Use ring-type connectors for No. 10 AWG and smaller on stud and post-type terminals and any termination subject to vibration.

.1 Twist-on connectors are limited for use on lighting circuits, control wiring in outlet boxes, luminaires, and with factory-supplied leads or pig-tails in field devices. Pre-twist the conductors tightly prior to installation of twist-on connectors. Do not use twist-on connectors inside panels and apparatus which are equipped with terminal blocks.

.2 Splice connectors for equipment pigtail, lighting, and receptacle circuits: For wire sizes #12 and #10 AWG inclusive, twist-on compression spring type. Wing-Nut by Ideal, Marrette Type II by Marr Electric Ltd., or approved equal.

.3 Use compression-type lugs for No. 8 AWG and larger unless equipment is provided with proper lugs designed for conductor terminations.

.1 Equipment pig-tail power circuit connections: For wire sizes #8 AWG minimum, split-bolt type, sized to suit number and size of conductors. SERVIT Type KS by Burndy Inc. , or approved equal.

.4 Unless motor connection boxes are equipped with terminals, use compression-type motor connection lugs and machine bolts with belville washers at motors for conductors up to No. 1 AWG. For No. 1/0 AWG and larger conductors use two-hole long barrel compression lugs and apply self-vulcanizing tape or heat-shrink end cap over termination.

.5 In moist or corrosive areas, apply joint compound to conductor prior to installation of compression fitting.

.6 Exercise care in stripping insulation from wire. Do not nick conductors.

.7 Strictly follow manufacturer's instructions with regards to tool size and application methods of terminations and compounds.

3.10 Accessories

.1 Cable grips: To accommodate type and geometry of cable supported, single weave, variable mesh design, by ABB (Thomas and Betts), Eaton (Crouse Hinds), or approved equal.

3.11 Colour Coding

.1 See Division 26 - Common Work Results for Electrical for additional requirements, and City of Winnipeg standards.

.2 Colour code all power distribution and control conductors at both ends throughout Facility.

.3 Same colour for same phase throughout, by insulation colour or permanently applied colour banding at all distribution centres, panels and outlet boxes.

.4 Colour tape shall be vinyl, 19 mm wide.

.5 Conductor Colour coding to be in accordance with CEC and as follows:

Conductor	**Colour**
Equipment Grounding Conductor	Green
Neutral Conductor	White
1 Phase, 3 Wire	Red, Black, White
3 Phase	Red (Phase 1), Black (Phase 2), Blue (Phase 3)
DC (Positive), 3 Wire	Red
DC (Negative), 3 Wire	Black
DC (Ground), 3 Wire	White or Gray

3.12 Cable Identification Tags

.1 See Division 26 - Common Work Results for Electrical for additional requirements.

.2 Sleeve: Permanent, PVC, white, with legible machine-printed black markings.

.1 Manufacturer and Product: Raychem; Type D-SCE or ZH-SCE.

.3 Heat Bond Marker:

.1 Transparent thermoplastic heat bonding film with acrylic pressure sensitive adhesive.

.2 Self-laminating protective shield over text.

.3 Machine printed black text.

.4 Manufacturer and Product: 3M Co.; SCS-HB.

.4 Marker Plate: Nylon, with legible designations permanently hot stamped on plate.

.5 Tie-On Cable Marker Tags:

.1 Chemical resistant white tag.

.2 Size: 13 mm by 51 mm.

.3 Manufacturer and Product: Raychem; Type CM-SCE.

.6 Grounding Conductor: Permanent green heat-shrink sleeve, 51 mm minimum.

.7 Cable Ties:

.1 Nylon, adjustable, self-locking.

.2 Use nylon cable ties only in horizontal cable tray runs to secure cables to the tray. Nylon cable ties are not to be used for cable support.

.3 Manufacturer and Product: Thomas & Betts Ty-Rap.

.8 All 120/208V power cables require a tag. If tag is not indicated on Drawings, request tag from Contractor Administrator.

.9 Use wire markers in terminating all wiring, including but not limited to power, control, signal, communication, and lighting wiring.

.10 Identify all multi-conductor cables at all termination points with wire markers. In addition to identifying the cable, identify each of the individual conductors at all termination points, unless it is a colour-coded power conductor. All cable markers must be readily visible when the device cover is open.

.11 All control conductors shall have wire numbers at both ends of each wire using Brady heat shrink sleeves with typewritten wire numbers. Wire markers shall have a white background and black lettering. Handwritten tags on adhesive tape is not acceptable. The Contractor shall adhere to the tagging scheme shown on the control Drawings.

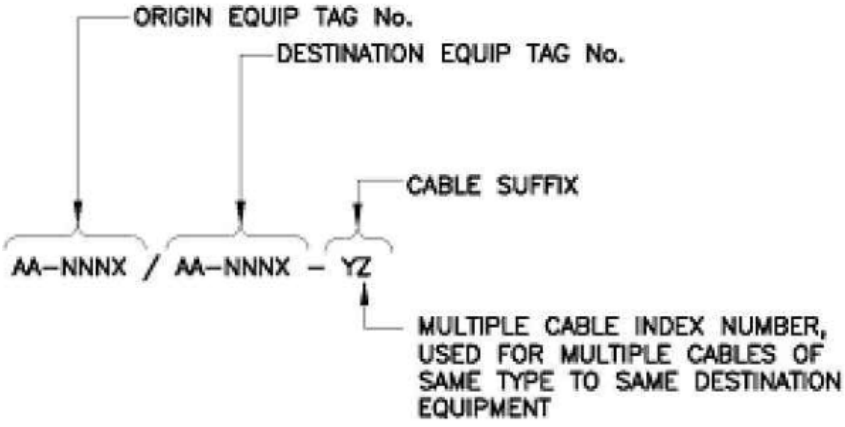
.1 Heat shrink insulation shall be used where additional insulation or dressing of connected cables is required. Electrical tape shall not be used for additional insulation or dressing of connected cables. The use of heat shrink tubing and electric heat gun to heat the shrink tubing is the required method.

.1 Thermally stabilized, crosslinked polyolefin.

.2 Manufacturer and Product: Thomas & Betts Shrink-Kon. or approved equal.

3.13 Cable Tagging

.1 Cables shall be identified by Original Equipment Tag, Destination Equipment Tag, and Cable suffix. All cables shall have the full tag for complete identification, partial tagging is unacceptable.



.1 Cable Suffix “Y”:

.1 For Instrument/Control Cable types use:

.1 A = Analog Cable.

.2 C = Control Cable.

.3 D = Data Cable.

.4 E = Ethernet Cable.

.5 F = Fiber Cable.

.6 S = Security Cable.

.7 T = Telephone Cable.

.2 For Power cable types use:

.1 P = Power Cable.

.2 M = Motor Cable.

.2 Cable Suffix “Z” examples have been provided, use the appropriate number of sets:

.1 One set of cable = 1.

.2 Two sets of cables = 2.

.3 Example Cable Tags (full identification) has been provided:

.1 Example Power Feed Cable: CSTE-1 / SWBRD-001-P3.

.2 Example Motor Cable: MCC-1 / P-100-M1.

.3 Example Instrument Cable: LCP-PLC-001 / 30-FIT-4112-A1.

3.14 Testing

.1 As required under Division 26, other divisions, by manufacturers, and by vendors.

.2 See Division 26 - Common Work Results for Electrical for additional requirements.

.3 See Division 26 – Commissioning of Electrical Systems for additional requirements.

END OF SECTION

1. GENERAL

1.1 Description

.1 Supply and install a complete permanent, continuous grounding system to include new equipment provided in this Contract. Securely and adequately ground all components of the electrical system in accordance with the requirements of all related sections in the latest Canadian Electrical Code, Local Building Code, the local Electrical Inspection Branch, and the contract documents.

.2 Provide a single, complete, integrated grounding system, including conductors, raceways, and connections, indicated and specified, and in accordance with the CSA. The system is to consist of cables, supports, and all necessary materials and inter-connections to provide a complete system. Measured resistance to ground of the network shall not exceed 5 ohms.

.3 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Switchgear, substations, motor control centers (MCC), electric equipment enclosures etc., outdoor substations, transformers, switch structures, frames of motors, duct systems, control panels, generators, elevators and escalators, distribution panels, outdoor lighting etc.; ground grid systems with ground rod and water pipe connections; structural steel (building steel work), and lightning protection system.

.4 Include grounding conductors completely inter-connecting water supply pipe, ground rods, ground grid, substation, switchgear and motor control center ground buses, other distribution equipment, and other groundable equipment.

1.2 References

.1 ASTM International (ASTM):

.1 B3, Standard Specification for Soft or Annealed Copper Wire.

.2 B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

.3 B33, Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes.

.2 Canadian Standards Association (CSA):

.1 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations, and Update No. 1.

.2 CSA C22.3 No. 3, Electrical Coordination.

.3 CSA C22.2 No. 27, Busways (Tri-national standard with UL-857 and NMX-J-148-ANCE).

.4 CSA B72, Installation code for lightning protection systems.

.3 Institute of Electrical and Electronics Engineers (IEEE):

.1 IEEE 80, Guide for Safety in AC Substation Grounding.

.2 IEEE 81, Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System.

.3 IEEE 142, Recommended Practice for Grounding of Industrial and Commercial Power Systems.

.4 IEEE 399, Recommended Practice for Industrial and Commercial Power Systems Analysis (Brown Book).

.5 IEEE 837, Qualifying Permanent Connections Used in Substation Grounding.

.4 National Fire Protection Association (NFPA):

.1 780, Lightning Protection Code.

.5 Underwriters Laboratories (UL):

.1 467, Standard for Grounding and Bonding Equipment.

1.3 Action and Informational Submittals

.1 Submit Shop Drawings and manufacturers' product data in accordance with requirements of Division 1 and Division 26.

.2 All hardware shall bear either CSA or cUL approvals.

.3 Submit catalog and dimensional data for the following:

.1 Ground rods.

.2 Connecting hardware.

.3 Product Data: Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.4 Submit all ground continuity and all ground resistance system test results.

2. PRODUCTS

2.1 Manufacturer's Compliance

.1 Manufacturer's acceptance contingent upon products' compliance with the specifications.

.2 Manufacturers adherence to the Canadian Electrical Code and UL Standard 467.

2.2 Grounding Conductors

.1 Provide copper grounding conductors bare or insulated, sized as indicated. When not indicated on the drawing provide in accordance with CSA. Provide protection of conductors in locations where physical damage would result from direct exposure.

.1 Grounding and bonding conductors for substations, main panels and distribution points, and ground rod connections shall be annealed copper type conforming to ASTM B3, stranded, with 98% conductivity.

.2 Unless noted otherwise, all conductors No. 8 AWG and larger shall be stranded, Class B in accordance with ASTM B8.

.1 Uninsulated conductors shall be bare copper in accordance with ASTM B3 for soft annealed copper (CU), tinned in accordance with ASTM B33.

.2 Use tinned-coated in corrosive/hazardous environments including when buried in earth, or embedded in concrete.

.2 Equipment and Facility bonding where portions of the underground installation are in RPVC conduit only: use green jacketed RWU90 XLPE, copper, size as indicated.

.1 Equipment ground conductors run with circuit conductors and grounding electrode conductor shall be 600 V with green insulation, unless noted otherwise on the Contract Documents.

.3 Portions of the installation are above ground with connection to the underground grounding system: Installations in vertical RPVC conduit with connection to the underground grounding system: use green jacketed RWU90 XLPE, copper, size as indicated.

.1 Conductors: PVC insulated coloured green, stranded soft annealed copper wire No. 10 AWG for grounding meter and relay cases.

.4 Grounding Conductor Electrode: All other portions of underground and/or exterior installations shall be direct burial in contact with bare earth: bare copper, size as indicated.

.1 Conductors: bare, stranded, soft annealed copper wire, size No. 4/0 AWG and 2/0 AWG for ground bus, electrode interconnections, metal structures, gradient control mats, transformers, switchgear, motors, ground connections etc.

.5 Interior Facility (cable trays, conduits, interconnections between switchgears/MCCs etc.) for above grade connections only.

.1 Ordinary Location: size as indicated, green jacketed, copper, with thermoplastic insulation type TWH rated at 600 V, minimum FT1, typically used for insulated ground wires. Alternatively, RW90 XLPE with minimum FT1 is also acceptable.

2.3 Connectors and Fasteners

.1 Dry Locations Only (above grade, or inspection wells):

.1 Cast, set screw, or bolted are permitted.

.2 Cadweld joints are permitted.

.3 Use mechanical connectors for grounding connections to equipment provided with lugs.

.2 Compression-tool applied. Burndy “Hyground Compression System,” or equal.

.3 Grounding lugs where furnished as standard manufacturer’s items on equipment.

.4 Provide ground clamps which are CSA listed for use on copper or brass pipes.

.5 Provide ground clamps, for use on iron pipes, of galvanized or malleable iron, or of standard noncorrosive material for use on iron pipes.

.6 Provide ground clamps, for use on pipes, with rigid metal base providing good contact by proper seating on the pipe. Do not use strap type clamps.

2.4 Ground Rod Electrode

.1 Vertical Rod electrodes: copper clad steel, shall be a minimum size of 19 mm (3/4”) diameter by 3 m (10 ft) long.

.1 Where ground wells are indicated, provide a 12 inch deep, 8 inch diameter precast concrete well with flush lid for accessibility and inspection of compressed connections.

.2 Ground rods shall be clean and smooth with the following characteristics:

.1 Cone-shaped point on the first section.

.2 Die-stamped near the top with the name or trademark of the manufacturer and the length of the rod in millimeters or feet.

.3 Install rod electrodes and make grounding connections.

2.5 Ground Plate Electrode

.1 Minimum copper surface area 2 m², 2 mm thick.

.2 Plate electrodes shall only be used in areas where bedrock prevents the use of vertical Rod electrodes. Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

.3 Install plate electrodes and make grounding connections.

2.6 Concrete Encased Electrode

.1 Copper conductor: minimum 6.0 m long for each concrete encased electrode, bare, stranded, tinned, soft annealed, size as indicated.

.2 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

.3 Install concrete encased electrodes with terminal connected to grounding network.

2.7 Ground Busbar Assemblies

.1 Facility Ground Busbar (for exposed wall-mount installations only):

.1 Provide tinned copper ground bar(s) complete with lugs suitable to terminate all ground cables, insulated supports, fastenings, connectors. Bus shall be complete with pre-drilled holes suitable for lug mounting as required. Refer to Drawings for further details.

.2 Installation shall be in accordance with CEC 10-616, and Table 16.

.3 Minimum cross-sectional area of the busbar shall be provided in accordance with Table 16, and the number of bonding connections required plus 20%. In smaller installations the minimum size shall be 12 mm thick, 100 mm high, and 1000 mm long.

.4 The minimum electrical rating for the ground bus shall be 600 V, factory complete with pre-installed 1.5 kV insulated stand-offs. Where installations call for back-to-back insulated stand-offs the ground bus shall first be ordered as a complete assembly that includes factory pre-installed insulated stand-offs to ensure the assembly arrives to site CSA certified/listed. Only onsite shall additional back-to-back insulated stand-offs be installed in addition to the standoffs that already come with the CSA certified/listed busbar assembly.

.5 The facility ground busbar assembly shall be ordered as a complete unit including insulated standoffs to maintain its certified/listing to C22.2 No. 27 (joint standard with UL 857 and NMX-J-148-ANCE). This standard applies to service-entrance, feeder, and branch-circuit busways and associated fittings rated at 600V or less, 6000A or less, and intended for use in accordance with the CEC (and NEC), NFPA 70, and the Mexican standard for Electrical Installations (Utility, NOM-001-SEDE). These requirements do not apply to metal enclosed bus intended for connecting switchgear assemblies for use in prefabricated electrical distribution systems.

.2 Cables shall be connected to ground bars via heavy duty, 2 Hole, compression Lug Connector for bolt-on connection to the ground busbar.

.1 Connectors for cables equal or less then 2/0 shall be compact type.

.2 Connectors for cables equal or grater then 3/0 shall be brazed type.

.3 Exterior/Outdoor Ground Busbar:

.1 The same requirements as the Facility ground Busbar above except:

.1 Bus bar shall have a minimum 18 pre-drilled holes, two standoff insulators, two stainless steel mounting brackets and four stainless steel assembly bolts and lock washer.

.2 The ground busbar assembly shall be installed an enclosure with a minimum rating of CSA/NEMA 3R.

2.8 Accessories

.1 Shall be non-corroding type, necessary for complete grounding system, type, size material as indicated, including:

.1 Grounding and bonding bushings.

.2 Protective type clamps.

.3 Bolted type conductor connectors.

.4 Thermit welded type conductor connectors.

.5 Bonding jumpers, straps.

.6 Pressure wire connectors.

2.9 Manufacturers

.1 Ground Rods (Copper):

.1 Thomas & Betts (ABB).

.2 Compression Connecting Hardware:

.1 Thomas & Betts (ABB).

.2 Brundy.

.3 Ground bar (tin plated) with Insulated Standoffs:

.1 Erico.

3. EXECUTION

3.1 Installation – General

.1 Make special provision for installing electrodes that will give acceptable resistance to ground value, where rock or sand terrain prevails.

.2 Install complete permanent, continuous grounding system, including conductors, accessories. All connectors shall be installed in accordance with Manufacturers' requirements, and to the requirements of the local Authority Having Jurisdiction (AHJ). All frames and metallic enclosures of all electrical equipment and electrically operated equipment shall be grounded via a ground conductor.

.3 All bolted connections must be accessible.

.4 Bond individual cable tray sections with bonding jumpers.

.5 Ground all utility services to the electrical system ground.

.6 Bond all building columns, structural steel, and metal siding, within or forming part of building/facility envelope. Including any current carrying exposed metal such as fences, tanks, equipment, or structures using copper welding by thermit process.

.7 Expansion joints and telescoping sections of raceways shall be bonded using jumper cables as per Canadian Electrical Code.

.8 Protect exposed grounding conductors from mechanical injury.

.9 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

.10 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.

.11 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process.

.1 Make ground connections to continuously conductive underground water pipe on street side of water meter.

.12 Ground secondary service pedestals.

.13 Protect exposed grounding conductors during and after construction.

3.2 Compression Fittings

.1 Use compression connectors for all grounding splices and terminations unless otherwise shown on the Drawings.

.2 Compression fittings will make a connection without corroding or loosening.

.3 The compression joint shall join all strands and not cause the parts to be damaged or weakened.

.4 Completed connection or joint shall be equal or larger in size than the conductors joined and have the same current-carrying capacity as the largest conductor.

.5 Paint buried ground connection with a bitumastic paint.

3.3 Installation of Grounding Conductors

.1 Install grounding conductors so that they will not be exposed to physical damage. Install connections firm and tight. Arrange conductors and connectors so no strain on connections.

.2 Run grounding conductors associated with direct burial cables in common trenches above cables except as indicated otherwise.

.3 Bury equipment grounding conductors 30 inches deep. Bring loops or taps up for connection to equipment or other items to be grounded.

.4 Where raceways are used to contain and protect grounding conductors, install in accordance with Division 26.

.5 Where bare grounding conductors are contained within metallic raceways, bond ends of raceways to conductors.

.6 Install loop type, low impedance, grounding system interconnecting all components so at least two grounding connections are provided for each major item of electrical equipment. Ensure that severing of any single grounding conductor in this system does not remove grounding protection on any major item.

.7 Connect structural steel to the external perimeter loop of grounding conductors installed around all sides of building foundation as indicated on the drawings otherwise buried a minimum 30 inches below grade. Connect to each vertical column by loop or tap. Connect two opposite points on external loop to two different points on grounding system.

.1 Connect building structural steel and metal siding to ground by welding copper to steel.

.8 Make accessible connections to structural members by bolted connector. Connections to equipment or ground bus by bolted connectors.

3.4 Installation of Ground Rods

.1 Install ground rods in manholes in accordance with requirements specified under the section Underground Distribution Systems. Connect each grounding conductor entering a manhole to ground rod by compression joint.

.1 Install conveniently located grounding electrode and size 3/0 stranded copper conductor in each manhole.

.2 Install ground rod in each manhole so that top projects through bottom of manhole. Provide with lug to which grounding connection can be made.

.2 Install ground rods where indicated. Unless otherwise indicated on the drawings, install the top of the rod 12 inch (300 mm) below the ground surface.

.3 Make connection to overall grounding system as indicated.

.4 Connect individual ground rods to the grounding loop using the direct burial grounding cable.

.5 Make grounding connections in radial configuration only, with connections terminating at single grounding point with CT’s of equal spacing. Avoid loop connections.

3.5 Equipment Grounding

.1 Connect grounding conductors from equipment in area where ground bus is required to ground bus. Connect ground bus to grounding system.

.2 All frames and metallic enclosures of all electrical equipment and electrically operated equipment shall be grounded via a ground wire. Use mechanical connectors for grounding connections to equipment provided with lugs.

.3 Facility Distribution Equipment:

.1 All service equipment, power transformers, switchgear, motor control centers (MCCs), switchboard/panelboards and splitters fed from the main distribution centre shall be grounded by grounding conductors sized as shown, or as required by code. The ground conductor shall be terminated at each end with an appropriate grounding lug which shall be connected to the equipment ground bus. Provide grounding conductor with green insulation. Use mechanical connectors for grounding connections to equipment provided with lugs.

.1 Install electrical room ground bus to wall at location as indicated, utilizing insulated off sets.

.2 All main distribution centres, MCCs, switchgear, and all panels requiring equipment grounds shall contain a ground bus of adequate size, and tapped for lugs for the ground conductor required.

.3 Connect two (2) separate ground connections from ground grid to ground bus of switchgear assemblies, MCCs, switchboards and all outdoor substation and transformer equipment. Ensure that each connection for item of equipment is from different section of ground grid.

.4 Connect a grounding conductor between panelboard and grounding system. Where a grounding bar is furnished with panelboard, connect grounding conductor to bar.

.5 Connect power transformer cases and neutrals to grounding system. Connect neutral ground connection at transformer terminal. Provide two (2) separate, independent, diagonally opposite, connections for power transformers so removal of one connection will not impair continuity of other.

.1 Connect generator neutral to grounding system by a grounding conductor. Connect grounding conductor to generator disconnect enclosure and generator neutral on generator side of disconnect. Ground generator frame with two separate independent connections, so removal of one connection will not impair continuity of other.

.2 All sub panels such as lighting panels, local distribution panelboards, etc., shall be grounded with a green ground conductor run back to the panel from which it is fed. The ground conductor shall be sized according to the Canadian Electrical Code.

.3 Install grounding connections to duct systems, frames of motors, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting.

.4 Connect surge protection devices to ground system by suitable conductors. Where lightning arresters are furnished with electrical equipment and grounding connections are not inherently provided, ensure that suitable separate grounding conductor connects lightning arresters with system ground.

.5 Other Equipment:

.1 Ground each piece of electrical equipment by means of a grounding & bonding conductor installed in raceway feeding that piece of equipment. Grounding conductors installed in conduit with insulated conductors to be furnished with green, 600 volt insulation. Ground conductors are in addition to and not to be considered as the neutral wire of the system, and may be additional bonds as indicated on the drawings.

.2 All motors shall be bonded by means of an adequately sized ground conductor contained within the feeder cable. In larger sized motors installations, or as indicated on the drawings, or where specialty applications require it provide an additional bonding conductor.

.1 Install a separate grounding conductor from ground system to motors of 100 horsepower and larger, in addition to the raceway system. Ground motor ground connection to motor frame, independent of mounting bolts or sliding base. Ground motor to nearest point on grounding system, unless otherwise indicated.

3.6 Conduits

.1 Include a separate green ground conductor in all power conduits including branch circuit wiring sized to Canadian Electrical Code.

.2 Install RPVC conduit sleeves where ground conduits pass through concrete slabs.

.3 Conduit installed buried in earth or installed in or under grade floor slabs shall have separate ground conductors installed.

.4 Conduits entering metal enclosures shall utilize bonding type locknuts and grounding bushings. Locknuts that gouge into the metal enclosures are not acceptable.

.5 Where conduits are not effectively grounded by firm contact with a grounded enclosure, apply grounding bushings on at least one end of conduit run. Conduit connections shall be wrench tight.

.6 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.

3.7 Other Outdoor Grounding

.1 Ground each street lighting standard by ground rod driven near base of standard, in accordance with requirements of CSA. Connect ground rods to grounding conductor brought with street lighting feeder cable.

.1 Ground transformers, lightning arresters, insulators and other appurtenances, installed on poles, poles and timber structures, or metal structure. Run grounding conductors between poles or structure and ground rods. Install ground rod at base of pole and drive the rod down until it is a minimum of 300 mm (12”) below ground.

.2 Wood poles: Provide protective molding cover over the grounding conductor to a height at least 2500 mm (8 feet) above ground, with both molding and conductor stapled.

.3 Install separate ground conductor to outdoor lighting standards.

.2 Ground wire fences when used to enclose electrical equipment or when overhead electrical lines cross fence. Unless otherwise indicated, provide grounding by buried outside peripheral ground loop; connections to each corner fence post and nearby ground rod; flexible connections to each gate; and at least two connections to grounding system from approximately opposite positions on fence.

3.8 Signal Grounding

.1 Ground signal surge protection and shields of twisted, shielded cable using a signal bonding conductor. The signal bonding conductor shall be a continuous path from the instrument surge protection or shield to the grounding electrode conductor. The signal bonding conductor shall be isolated from the equipment grounding conductor for its entire path.

.2 Where convenient several signal bonding conductors may be combined, providing that all the following conditions are met:

.1 The combined signal bonding conductor shall have the equivalent cross section of the conductors that it was combined from or three times the cross section of the largest conductor that it was combined from, whichever is less.

.2 The combined signal bonding conductor shall be isolated from the equipment grounding conductor.

.3 Where two signal bonding conductors are combined use a three port insulated splice.

.4 Where three or more signal bonding conductors are combined, use a copper bus mounted on 600 volt insulators. Attach each conductor to the bus using an insulated ring tongue lug and screw terminal.

3.9 Neutral Grounding

.1 Install system and circuit grounding connections to neutral of secondary 600 V systems, secondary 208 V systems.

.2 Connect transformer neutral and distribution neutral together using 1000 V insulated conductor to one side of ground test link, the other side of the test link being connected directly to main station ground. Ensure distribution neutral and neutrals of potential transformers and service banks are bonded directly to transformer neutral and not to main station ground.

.3 Interconnect electrodes and neutrals at each grounding installation.

.4 Connect neutral of station service transformer to main neutral bus with tap of same size as secondary neutral.

.1 Run a second Neutral cable for transformers as indicated on the drawings.

.5 Ground transformer tank with continuous conductor from tank ground lug through connector on ground bus to primary neutral. Connect neutral bushing at transformer to primary neutral in same manner.

3.10 Communications Grounding

.1 Install grounding connections for telephone, sound, fire alarm, intercommunication systems as follows:

.1 Telephones: make telephone grounding system in accordance with telephone company's requirements.

.1 Install one No. 2 insulated ground conductor to ground bus in telephone equipment cabinet.

.2 Connect one No. 12 insulated ground conductor to all conduits terminating at backboard.

.2 Sound, fire alarm, intercommunication systems as indicated.

3.11 Field Quality Control

.1 Perform tests in accordance with Division 26.

.2 Test grounding systems for ground resistance. Total resistance from any point on the ground network to the building counterpoise must not exceed 50 milliohms.

.3 Ensure that final resistance of interconnected ground system is 5 ohms, or less.

.1 Ground resistance and counterpoise tests must be made during dry weather and no sooner than 48 hours after rainfall. Conditions of soil and weather shall be documented on test forms.

.2 Complete grounding testing and validations prior to backfill.

.4 Perform continuity test on all power receptacles to ensure that the ground terminals are properly grounded to the facility ground system.

.5 Indicating instrument must be self-contained and include a direct-current generator, synchronized current and potential reversers, crossed-current and potential coils, direct-reading ohmmeter, series resistors, and range-selector switch. Calibrate direct-reading ohmmeter for ranges of 0 to 20 ohms and 0 to 200 ohms.

.6 Perform ground continuity and resistance tests using method appropriate to Site conditions and to approval of Engineer and local Authority Having Jurisdiction over installation.

.1 Temporary disconnect the two grounding conductors between the facility ground busbar and the facilities underground grounding system. Reconnect when testing is complete.

.2 Mark on the drawings clarifying ground rod(s) where the testing took place (i.e. Gridline X and Gridline X).

.3 Optional Method 1 – The 4-pole Earth Resistance Test:

.1 On the markup drawing, include the Testing instrument electrode names and distance between them.

.2 Place auxiliary grounding electrodes in accordance with instrument manufacturer's recommendations but not less than 50 feet (15 m) apart, in accordance with IEEE Standard 81.

.4 Optional Method 2 – The Induced Frequency Method (Radio method):

.1 If proceeding with this method ensure a minimum of 4 ground rods are checked (i.e. at each corner of the grid or facility).

.2 Measures the ratio of the resistance to earth of an auxiliary test electrode to the series resistance of the electrode under test and a second auxiliary electrode. Perform measurements in accordance with IEEE Standard 81.

.7 Perform tests before energizing electrical system.

.8 Disconnect ground fault indicator during tests.

.9 Submit all ground continuity and resistance test results and markup sheets within three (3) days of field tests, and prior to commissioning activities for Contract Administrator's review.

3.12 Contract Closeout

.1 Provide in accordance with Division 1.

END OF SECTION

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

1. GENERAL

1.1 Work Included

.1 Supply and install all hangers, supporters and inserts for the installation shown on the Drawings and specified herein, as necessary to fasten electrical equipment securely to the building structure.

.2 Provide supports from building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

1.2 References

.1 ASTM International (ASTM):

.1 A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

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

.3 A924/A924M, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.

.4 E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

.5 E119, Standard Method for Fire Tests of Building Construction and Materials.

.6 E814, Standard Test Method of Fire Tests of Through Penetration Firestops.

.2 FM Global (FM):

.1 Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.

.3 Canada Standards Association (CSA):

.1 CSA C22.1, Canadian Electrical Code Part I (CEC) as amended by provincial, territorial or municipal authority having jurisdiction. References to CEC/MEC elsewhere in this document shall include reference to such amendments.

.4 Manitoba Electrical Code (MEC):

.1 Manitoba amendments to the Canadian Electrical Code.

.5 Underwriters Laboratories, (UL): Applicable listings.

.1 FRD, Fire Resistance Directory.

.2 263, Fire Tests of Building Construction and Materials.

.3 723, Test for Surface Burning Characteristics of Building Materials.

.4 1479, Fire Tests of Through-Penetration Firestops.

1.3 Submittals

.1 Submit the shop drawings in accordance with Division 1 and Division 26.

.2 Submit Shop Drawings and manufacturers' product data in accordance with the requirements of Section 26.

2. PRODUCT

2.1 Framing and Support System

.1 Materials:

.1 Intermediate duty supporting structures shall employ 41 mm square strut channel together with the Manufacturer’s connecting components and fasteners for a complete system.

.2 Heavy duty supporting structures to be fabricated and welded from steel structural members and prime painted before installation.

.3 Shall be rated for use in hazardous locations and category environments as necessary.

.4 Steel or malleable iron.

.5 Aluminum where indicated.

.6 Stainless steel where indicated.

.2 Coatings/Finishes:

.1 Provide products for use outdoors.

.1 Hot dipped galvanized.

.2 Supports, support hardware, fasteners, nuts, bolts, machine screws:

.1 Protect Steel and malleable iron:

.1 Cadmium plated for assemblies where sacrificial deterioration would normally take place damaging other fittings.

.2 Zinc coated where sacrificial deterioration will not take place.

.3 Use PVC coating where indicated on Drawings.

.3 Square strut channel:

.1 Section 41 mm square strut channel or as required for load and span, with mounting screws, or approved. 41 mm square strut channel is a minimum standard for supporting conduits 50 mm and larger.

2.2 Concrete and Masonry Anchors

.1 Materials: hardened steel inserts, zinc plated for corrosion resistance. All anchor bolts must be galvanized.

.2 Components: non-drilling anchors for use in predrilled holes, sized to safely support the applied load with a minimum safety factor of four (4).

2.3 Non-Metallic Anchors

.1 Material: plastic anchors for sheet metal screws.

2.4 Cable Supports and Clamps

.1 General: as per conduit supports, except that for single conductor cables, suitable non-ferrous, or approved stainless steel or aluminum clamps shall be used.

2.5 Manufactured Supporting Devices

.1 Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.

.2 Fasteners: Types, materials, and construction features as follows:

.1 Expansion Anchors: Carbon steel wedge or sleeve type.

.2 Toggle Bolts: All steel springhead type.

.3 Powder-Driven Threaded Studs: Heat-treated steel, designed specifically for intended service.

.4 Nuts, Washers, and Bolts: Stainless steel.

.3 Conduit Sealing Bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.

.4 Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers.

.5 U-Channel Systems: Channels, with 9/16 inch (14 mm) diameter holes, at minimum of 8 inch (200 mm) on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of same manufacture.

2.6 U-Channel Systems

.1 Manufacturers, Stainless Steel/Galvanized Steel Channel.

.1 Unistrut Corp.

.2 B-Line Systems, Inc.

.2 Provide Type 316 stainless steel channel with corresponding accessories.

.3 Channels, with 9/16 inch (14 mm) diameter holes, at minimum of 8 inch (200 mm) on center, in top surface.

.4 Provide fittings and accessories that mate and match with U-channel and are of same manufacture.

.5 Provide hot-dipped galvanized after fabrication for steel channel and accessories.

.6 Provide channel of the proper material to match equipment classifications.

2.7 Fabricated Supporting Devices

.1 Shop or field fabricate supports or manufacture supports assembled from U-channel components.

.2 Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.

.3 Pipe Sleeves: Provide pipe sleeves using one of the following:

.1 Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate sleeves from following gage metal for sleeve diameter noted:

.1 3 inch (75 mm) and smaller: 20 gage (0.9 mm).

.2 4 inch (100 mm) to 6 inch (150 mm): 16 gage (1.5 mm).

.3 Over 6 inch (150 mm): 14 gage (1.9 mm).

.2 Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe.

.3 Plastic Pipe: Fabricate from Schedule 80 PVC plastic pipe.

2.8 Fire Resistant Joint Sealers

.1 Manufacturers:

.1 “Dow Corning Fire Stop Foam,” Dow Corning Corp.

.2 “Pensil 851,” General Electric Co.

.3 Or Approved Equal.

.2 Two part, foamed-in-place, silicone sealant formulated for use in through penetration fire stopping around cables, conduit, pipes, and duct penetrations through fire-rated walls and floors.

.3 Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies in accordance with ASTM E814, by Underwriters’ Laboratories, Inc., or other testing and inspection agency acceptable to Authorities Having Jurisdiction.

3. EXECUTION

3.1 General

.1 Do not cut or drill beams, joists or structural steel unless written permission of the Contract Administrator is obtained.

.2 Distance between conduit or cable supports not to exceed code requirements.

.3 Supports to be suitable for the real loads imposed by equipment.

.4 Supports to be securely fastened, free from vibration and excessive deflection or rotation. Maximum deflections are 4 mm over a 1 m span and 8 mm over a 2 m span.

.5 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

.6 Provide rack with 25% spare capacity for multiple runs.

.7 Provide channel support with fittings for vertical runs of conduit and cables.

3.2 Installation

.1 Coordinate with structural system and with other electrical installations, the building manufacturer, or structural engineer. Ceiling installations shall only commence after confirming the anticipated weight and attachment locations have been coordinated with the building manufacturer, or structural engineer.

.2 Install supporting devices to fasten electrical components securely and permanently in accordance with CSA and Building code requirements.

.1 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.3 Secure equipment

.1 To solid masonry, tile and plaster surfaces with lead anchors or nylon shields.

.2 To poured concrete with expandable inserts.

.3 To hollow masonry walls or suspended ceilings with toggle bolts.

.4 For surface mount with twist clip fasteners to inverted T-bar ceilings. Ensure that T-bars are adequately supported to carry weight of equipment specified before installation.

.4 Fasten exposed conduit or cables to building construction or support system using straps.

.1 One-hole malleable iron or steel straps to secure surface conduits and cables 50 mm and smaller.

.2 Two-hole steel straps for conduits and cables larger than 50 mm.

.3 Beam clamps to secure conduit to exposed steel Work.

.5 Suspended support systems.

.1 Support individual cable or conduit runs with a minimum of 6 mm diameter threaded rods and spring clips.

.2 Support two (2) or more cables or conduits on channels supported by a minimum of 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.

.3 When selecting threaded rod utilize a safety factor of five (5) times the maximum load tray system load (i.e. the installed weight needs to be less than the maximum load divided by 5). Loading factors may vary by manufacturer, threading type and pitch, material properties, anchoring, accessories, mechanical/seismic moments, stiffners etc. Also refer to the manufacturers product literature for additional requirements and limitations.

.1 All other materials for the cable tray support system(s) shall be a minimum of three (3) times the weight of all cabling installed in the cable tray / channel.

Threaded Rod Size mm (inches)	**Maximum Load** kN (lbs)
6 (1/4)	1.07 (240)
8 (5/16)	1.78 (400)
10 (3/8)	3.24 (730)
13 (1/2)	6.00 (1350)
16 (5/8)	9.60 (2160)
19 (3/4)	14.37 (3230)
22 (7/8)	19.93 (4480)
25 (1)	26.24 (5900)

.6 The contractor shall NOT:

.1 Use plastic anchors unless for lighter loads. Use metal anchors for all other loads.

.2 Use wire lashing or perforated strap to support or secure raceways or cables.

.3 Use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of the Contract Administrator.

.4 Use Shot driven pins. These may only be used with written approval of the Contract Administrator.

.7 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.8 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.9 Raceway Supports: Minimum material requirements:

.1 Conform to manufacturer’s recommendations for selection and installation of supports.

.2 Strength of each support shall be adequate to carry present and future load multiplied by safety factor of at least 4. Where this determination results in safety allowance of less than 200 lbs (890 N), provide additional strength until there is minimum of 200 lbs (890 N) safety allowance in strength of each support.

.3 Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.

.4 Support parallel runs of horizontal raceways together on trapeze-type hangers.

.5 Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1 inch (25 mm) and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4-inch (6 mm) diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.

.6 In vertical runs, arrange support so load produced by weight of raceway and enclosed conductors is carried entirely by conduit supports with no weight load on raceway terminals.

.10 Vertical Conductor Supports: Install simultaneously with installation of conductors.

.11 Sleeves: Install in concrete slabs and walls and other fire-rated floors and walls for raceways and cable installations. For sleeves through fire rated wall or floor construction, apply CSA/cUL listed firestopping sealant in gaps between sleeves and enclosed conduits and cables. Refer to Building code, Division 7, and Division 26 for further requirements.

.12 Conduit Seals: Install seals for conduit penetrations of slabs below grade and exterior walls below grade and where indicated required by Code. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.

.13 Conduit extending through roof shall pass through ceiling box at roof line.

.1 Provide 14 gage (1.9 mm) minimum copper box complete with watertight soldered seams and flanged to serve as pitch pocket for each conduit.

.2 Install conduit and pitch pocket in advance of roofing work.

.14 Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to building structure, including but not limited to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, disconnect switches, and control components in accordance with following:

.1 Fasten by means of wood screws or screw type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring tension clamps on steel. Threaded studs driven by powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine or wood screws. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.

.2 Holes cut in concrete shall not cut main reinforcing bars. Fill holes that are not used.

.3 Load applied to any fastener shall not exceed 25% of proof test load. Use vibration and shock resistant fasteners for attachments to concrete slabs.

.15 Support outlet boxes, junction boxes, panel tubs, etc., independent of conduits running to them. Support conduits within 600 mm of outlet boxes. Support surface mounted panel tubs with a minimum of four (4) 6 mm fasteners.

.1 Use round or pan head screws for fastening straps, boxes, etc.

3.3 Channels

.1 Support electrical components as required to produce same structural safety factors as specified for raceway supports.

.2 Install metal U-channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.

.3 Install Type 316 stainless steel for mounting of electrical equipment in outdoor areas and on below grade, outside building and structure walls.

.4 Install galvanized steel channels for interior building mounting of electrical equipment except for those locations listed above and unless otherwise indicated.

.5 Concrete walls and ceilings: Surface mount set in poured concrete with a minimum size of 41 x 41 mm, 2.5 mm thick of U-shape type.

3.4 Contract Closeout

.1 Provide in accordance with Division 1.

END OF SECTION

SPLITTERS, JUNCTION, PULL BOXES, AND CABINETS

1. GENERAL

1.1 Section Includes

.1 Materials and components for splitters, junction, pull boxes and cabinets.

1.2 References

.1 Canadian Standards Association (CSA International):

.1 CSA C22.2 No. 0, General requirements – Canadian Electrical Code, Part II.

.2 CSA C22.2 No. 0.4, Bonding of electrical equipment.

.3 CSA C22.2 No. 14, Industrial control equipment.

.4 CSA C22.2 No.76, Splitters.

.5 CSA C22.2 No. 30, Explosion-proof equipment.

.6 CSA C22.2 No. 40, Junction and pull boxes.

.7 CSA C22.2 No. 94, Special Purpose Enclosures.

.8 CSA C22.2 No. 94.1, Enclosures for electrical equipment, non-environmental considerations (Tri-national standard with NMX-J-235/1-ANCE and UL-50).

.9 CSA C22.2 No. 94.2, Enclosures for electrical equipment, environmental considerations (Tri-national standard with NMX-J-235/2-ANCE and UL-50E).

.10 CSA C22.2 No. 286, Industrial control panels and assemblies.

.2 Electrical Equipment Manufacturers Association of Canada (EEMAC), now known as Electro-Federation Canada.

.3 Manitoba Building Code (MBC):

.1 The Buildings and Mobile Home Act amendments to the National Building Code of Canada (NBC).

.4 Manitoba Electrical Code (MEC):

.1 Manitoba amendments to the Canadian Electrical Code (CEC).

.5 National Electrical Manufacturers Association (NEMA):

.1 NEMA ICS 6, Industrial Control and Systems: Enclosures.

.6 Winnipeg Electrical By-law (WEB):

.1 Winnipeg amendments to the Canadian Electrical Code (CEC).

.7 Winnipeg Building By-law (WBB):

.1 Winnipeg amendments to the National Building Code of Canada (NBC).

.8 Underwriters Laboratories Canada (cUL):

.1 508A, Industrial Control Panels.

.2 698A, Industrial Control Panels Relating to Hazardous (Classified) Locations.

.3 1203, Explosion Proof and Dust-Ignition Proof Electrical Equipment for Use in Hazardous (Classified) Locations.

1.3 Shop Drawings and Product Data

.1 Submit Shop Drawings and product data indicating the components and equipment/cabinets in accordance with Division 1 and Division 26.

.1 Manufacturer's data sheets for each type of junction box, cabinet, splitter, and pull box.

.2 Provide Manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size/dimensions, enclosure ratings, lug/terminal ratings, accessories/components, finish and limitations.

.1 Provide clarification in which area each type of enclosure / box will be installed, and its intended application.

.3 All materials shall be CSA certified or cUL listed and selected for the application and the environment for which it is installed in. When codes or standards require the enclosure to be certified it shall be manufactured and certified by a local panel shop. Refer to the drawings and Division 26 for additional information on the intended CSA/NEMA/EEMAC ratings of enclosures by area.

2. PRODUCTS

2.1 Environmental Considerations

.1 Intended to be installed in dry, non-hazardous, non-corrosive process locations:

.1 To be constructed of painted, mild steel.

.2 Back-plate with offsets for installation of devices.

.3 Continuous piano hinge, gasketed seal on door with quarter turn latch and handle.

.2 Intended to be installed in wet or corrosive locations:

.1 Constructed of cast aluminum with threaded connection.

.2 Termination of underground PVC conduit system may be made into an exterior mounted, rigid PVC or Fiberglass enclosure type 4X as applicable.

.3 Utilize 316 stainless steel bolts, washers and mounting hardware.

.3 Intended to be installed in hazardous locations:

.1 Constructed of cast copper free aluminum with threaded connection.

.2 Hinged, bolt-on style aluminum cover with neoprene gasket.

.3 Factory installed aluminum mounting plate for terminals, lugs and electrical devices.

.4 Factory installed threaded openings for conduit and cable connections.

.5 Utilize 316 stainless steel bolts, washers and mounting hardware.

2.2 Junction Boxes, and Pull Boxes

.1 Materials:

.1 Code gauge sheet steel, welded construction, phosphatized and factory paint finish.

.2 Components:

.1 For flush mounting, covers to overlap box by 25 mm minimum all around with flush head cover retaining screws.

.2 Use rolled edges for surface boxes.

2.3 Splitters

.1 General:

.1 Three (3) sets of lugs for phases plus neutral, minimum, sized and suitable for conductor termination.

.2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.

.3 Provide ground bar, with a minimum of three (3) terminals.

.2 Splitters shall include a hinged lockable cover.

.3 Do not install splitters in hazardous or corrosive areas. If required, install suitable, Class I junction boxes.

2.4 Cabinets

.1 Materials:

.1 Locks: to match panelboards.

.2 Components:

.1 With hinged door and return flange overlapping sides, with handle, lock and catch for surface mounting, size as indicated or to suit.

.2 Install a back mounting plate for DIN rail mounted terminal blocks. Plate to be painted white enamel.

.3 Install metal divider in cabinets with more than one voltage.

.4 Surface or flush with trim and hinged door, latch and lock and two (2) keys, size as indicated or to suit. Keyed to match panelboard keys 19 mm.

3. EXECUTION

3.1 Installation

.1 Boxes mounted in exterior walls shall be complete with box vapour barriers and gasketing/flashing/sealing per Manitoba Building Code. Maintain wall insulation.

.2 Install in inconspicuous but accessible locations, with a minimum 1m of clearance in front of the equipment in accordance to CEC for working space, and to egress requirements per Building Code.

.1 If junction boxes are required in inaccessible location, provide a suitable access panel which allows sufficient space for opening the junction box.

.3 Junction Boxes and Pull Boxes:

.1 Supply all pull boxes and junction boxes shown on the Drawings or required for the installation.

.2 Boxes installed in party walls to be offset by a minimum of one stud space.

.3 Install in inconspicuous but accessible locations, above removable ceilings or in electrical rooms, utility rooms or storage areas.

.4 Identify with system name and circuit designation as applicable.

.5 Size in accordance with the Canadian Electrical Code, as a minimum.

.6 Terminate cables and conductors as required.

.1 For control signals install terminal block, Weidmuller WDU4 or equivalent.

.7 Make all necessary cable entry holes in junction boxes supplied by Contractor or others, regardless of material.

.4 Splitters:

.1 Install splitters and mount plumb, true and square to the building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

.5 Cabinets:

.1 Mount cabinets with top not greater than 1980 mm above finished floor, coordinated with masonry, panelboards, fire hose cabinets and similar items.

.2 Install terminal block, Weidmuller WDU4 or equivalent.

.6 Unapproved Electrical Equipment:

.1 The Manitoba Electrical Code (MEC) allows the use of an unapproved Control Box provided all the requirements as outlined under MEC 2-204-4 are followed and provided.

.1 Clarification: Within the jurisdiction of Winnipeg the WEB 2-024 does not allow use of unapproved electrical equipment. Therefore the use any unapproved electrical equipment will be rejected and will require either complete replacement, or the contractor will provide CSA Special inspection certification and remediation of the same at no additional cost to the Contract.

3.2 Identification

.1 Provide equipment identification in accordance with Division 26.

END OF SECTION

1. GENERAL

1.1 Work Included

.1 Provide a complete installation which includes various boxes and materials for the miscellaneous wiring and equipment as required throughout the contract documents.

1.2 References

.1 Canadian Standards Association (CSA):

.1 CSA C22.1: Canadian Electrical Code Part I (CEC) as amended by provincial, territorial or municipal authority having jurisdiction. References to CEC/MEC elsewhere in this document shall include reference to such amendments.

.2 CSA C22.2 No. 14, Industrial control equipment.

.3 CSA C22.2 No. 18.1, Metallic outlet boxes (Tri-national standard with ANCE NMX-J-023/1 and UL514A).

.4 CSA C22.2 No. 18.2, Nonmetallic outlet boxes.

.5 CSA C22.2 No. 18.3, Conduit, tubing, and cable fittings (Tri-national standard with ANCE NMX-J-017 and UL514B).

.6 CSA C22.2 No. 18.4, Hardware for support of conduit, tubing, and cable (Bi-national standard with UL-2239).

.7 CSA C22.2 No. 18.5, Positioning devices (Bi-national standard with UL-1565).

.8 CSA C22.2 No. 25, Enclosures for use in Class II, Division 1, Groups E, F, and G hazardous locations.

.9 CSA C22.2 No. 30, Explosion-proof equipment.

.10 CSA C22.2 No. 213, Non-incendive electrical equipment for use in Class I and II, Division 2 and Class III, Division 1 and 2 hazardous (classified) locations (Bi-national standard with ISA 12.12.01)

.2 Winnipeg Electrical By-law (WEB):

.1 Winnipeg amendments to the Canadian Electrical Code (CEC).

.3 Winnipeg Building By-law (WBB):

.1 Winnipeg amendments to the National Building Code of Canada (NBC).

.4 Underwriters Laboratories Canada (cUL):

.1 886, Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.

.2 1203, Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations.

1.3 Shop Drawings and Product Data

.1 Submit product data in accordance with Division 1 and Division 26.

2. PRODUCTS

2.1 Boxes/Bodies General

.1 Size boxes as required to accommodate wiring devices, and in accordance with the CEC.

.2 Boxes shall be environmentally rated and suitable for the installation location. Refer to the drawings and Division 26 for area classifications and additional requirements.

.3 A minimum 100 mm (4”) square or larger outlet boxes as required for special devices.

.4 Gang boxes where wiring devices are grouped.

.5 Blank cover plates for boxes without wiring devices.

.6 Combination boxes with barriers where outlets for more than one system are grouped.

.7 Knock-out covers for sealing penetration holes.

2.2 Sheet Metal Boxes – Dry Unclassified Area

.1 Hot dipped galvanized steel.

.2 All 100 mm (4”) square boxes shall be minimum 40 mm deep.

.3 Deep boxes shall be installed where required.

.4 Device boxes shall be minimum 64 mm deep.

2.3 Boxes for Rigid Metal Conduit – Non-Explosionproof

.1 Materials:

.1 Surface mounting exposed: cast copper-free aluminum, ferrous for threaded rigid conduit, with attached mounting lugs, with factory-threaded hubs and plugs, two coats corrosion resistant finish, wet location rated, gasketed covers.

.2 Ceiling outlets (surface mounting):

.1 Manufacturer/Model: Eaton (Crouse-Hinds) VXF/VFT series, or approved equal.

.3 Wall outlets, Wall switches, and Device Boxes (surface mounting):

.1 For exposed mounting either indoors or outdoors.

.2 Single gang, 2-gang, 3-gang as required.

.3 Manufacturer/Model: For one or more gang, Eaton (Crouse-Hinds) FS series or FD series, or approved equal.

.4 Covers: unless wiring devices and plates are mounted, provide blank, round canopy covers to match boxes.

.4 Conduit Junction Boxes (surface mount):

.1 Minimum size of 100 mm (4") round.

.2 Manufacturer / Model: Eaton (Crouse Hinds) GRF or VXF series, or approved equal.

.5 Condulet Outlet Bodies:

.1 For wiring pull points.

.2 Manufacturer / Model: Eaton (Crouse Hinds) Form 7 series, (C, E, L, LB, LL, LR, T, TA, TB, X) to suit the application, or approved equal. All blank covers to be cast aluminum, gasketed wedgenut style covers.

2.4 Boxes for Rigid Metal Conduit – Explosion Proof

.1 Materials:

.1 Surface mounting exposed: cast copper-free aluminum, ferrous for threaded rigid conduit, with attached mounting lugs, with factory-threaded hubs and plugs, two coats corrosion resistant finish, wet location rated, gasketed covers.

.2 Rated for the Hazardous Location.

.2 Conduit Junction Boxes (surface mount):

.1 Minimum size of 100 mm (4") round.

.2 Manufacturer / Model: Eaton (Crouse Hinds) GUA, GUR, EAB, EAJ series, or approved equal.

.3 Condulet Outlet Bodies:

.1 For wiring pull points.

.2 Manufacturer / Model: Eaton (Crouse Hinds) OE series, LBH series, LBY series to suit the application, or approved equal.

.4 Wall outlets, Wall switches, and Device Boxes (surface mounting):

.1 Single gang, 2-gang, 3-gang as required.

.2 For exposed mounting either indoors or outdoors.

.3 Manufacturer / Model: Eaton (Crouse Hinds) EDS or EDSCM series to suit the application, or approved equal.

2.5 Fittings - General

.1 Materials and type to suit the conduit type and the installation requirements.

.2 Bushing and connectors with nylon insulated throats.

.3 Knock-out fillers to prevent entry of debris.

.4 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.

.5 Double locknuts and insulated bushings on sheet metal boxes.

.6 Thread Lubricant

.1 Use thread lubricant to prevent galling of conduit threads when threaded into a coupling, junction box etc. Maintains grounding continuity.

.2 Manufacturer / Model:

.1 Eaton (Crouse Hinds) HTL series.

.2 Emerson (Appleton) TLC series.

.3 Hubbell (Killark) LUBG/LUBT series.

2.6 Fittings for Rigid Metal Conduit – Explosion Proof

.1 Copper free aluminum, threaded fittings for explosion proof hazardous areas.

.2 Sealing fittings:

.1 Manufacturer / Model:

.1 Eaton (Crouse Hinds) EYS-SA, EZS-SA.

.2 Emerson (Appleton) type EYF-AL or EYM-AL.

.3 Hubbell (Killark) type EY or EYS.

.3 Drain sealing fittings:

.1 Manufacturer / Model:

.1 Eaton (Crouse-Hinds) type EYD-SA or EZD-SA.

.2 Emerson (Appleton) type EYDM-A.

.4 Drain / breathers:

.1 Manufacturer / Model:

.1 Eaton (Crouse Hinds) ECD series

.2 Emerson (Appleton) type ECDB.

.5 Threaded unions:

.1 Manufacturer / Model: Crouse Hinds UNF/UNY series to suit the application, or approved equal.

.6 Sealing Compound:

.1 All sealing compounds and manufacturer specific requirements shall be followed, and shall match those listed under the CSA certificate or cUL listing.

.2 Manufacturer / Model:

.1 Eaton (Crouse Hinds) Chico sealing compound or Chico speed seal.

Emerson (Appleton) Kwiko sealing compound and fiber filler.

.2 Hubbell (Killark) Killark sealing compound and fiber filler.

.7 Thread Lubricant:

.1 Use thread lubricant to prevent galling of conduit threads when threaded into a coupling, junction box etc. Maintains grounding continuity.

.2 Manufacturer / Model:

.1 Eaton (Crouse Hinds) HTL series.

.2 Emerson (Appleton) TLC series.

.3 Hubbell (Killark) LUBT series.

3. EXECUTION

3.1 Installation

.1 Adjust position of outlets in finished masonry walls to suit course lines. Coordinate cutting of masonry walls to achieve neat openings for all boxes.

.2 Outlets installed in partition walls to be offset by a minimum of one stud space.

.3 Confirm the direction of door swings on site, to confirm that outlet boxes for light switches are located on the latch side of the door.

.4 Provide boxes sized as required by the CEC.

.1 Extension rings shall not be utilized to accommodate conductor fill requirements.

.2 Do not use sectional boxes.

.5 Support boxes independently of connecting conduits.

.6 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of Work.

.7 Install all outlets flush and surface mounted as required for the installation.

.1 Surface mount above suspended ceilings, or in unfinished areas.

.2 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

.3 Use plaster rings to correct depth. Use 30 mm on concrete block.

.8 Do not distort boxes during installation. If boxes are distorted, replace with new boxes.

.9 Primary bushings in termination box for cable connection.

.10 Secondary bushings in termination box for bus duct connection.

.11 Control junction box.

.12 Exterior or wet, and/or corrosive areas:

.1 Boxes mounted in exterior walls shall be complete with box vapour barriers and gasketing/flashing/sealing per Manitoba Building Code. Maintain wall insulation.

.2 Install aluminum, threaded, gasketted, outlet boxes, conduit boxes, and fittings.

.13 Hazardous areas:

.1 Install aluminum, threaded, sealing fittings, conduit boxes, outlet boxes, unions, drains, expansion fittings, flexible couplings, and all other components approved for the hazardous area(s).

.2 Install fittings and seals in accordance with the Manufacturers requirements.

.3 The installation shall meet all requirements of the CEC, Section 18 and Section 22.

3.2 Identification

.1 Provide equipment identification in accordance with Division 26.

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section provides a comprehensive list of all conduit types that may be required for the project and the applications where each type shall be used.

.2 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section. This section supplements requirements of other Divisions.

1.2 References

.1 Canadian Standards Association (CSA):

.1 CSA C22.1: Canadian Electrical Code Part I (CEC) as amended by provincial, territorial or municipal authority having jurisdiction. References to CEC/MEC elsewhere in this document shall include reference to such amendments.

.2 CSA B137.1 Polyethylene (PE) Pipe, Tubing, and Fittings for Cold Water Pressure Services.

.3 CSA C22.2 No. 18.1 Metallic Outlet Boxes.

.4 CSA C22.2 No. 18.2 Non-metallic Outlet Boxes.

.5 CSA C22.2 No. 18.3 Conduit, Tubing, and Cable Fittings.

.6 CSA C22.2 No. 18.4 Hardware for the Support of Conduit, Tubing, and Cable.

.7 CSA C22.2 No. 18.5 Positioning Devices.

.8 CSA C22.2 No. 45.1 Electrical Rigid Metal Conduit – Steel.

.9 CSA C22.2 No. 45.2 Electrical Rigid Metal Conduit — Aluminum, Red Brass, and Stainless Steel.

.10 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.

.11 CSA C22.2 No. 83, Electrical Metallic Tubing (EMT).

.12 CSA C22.2 No. 211.1, Rigid types EB1 and DB2/ES2 PVC conduit.

.13 CSA C22.2 No. 211.2, Rigid PVC (unplasticized) conduit.

.14 CSA C22.2 No. 211.3, Reinforced Thermosetting Resin Conduit (RTRC) and Fittings (Bi-National standard with UL-1684).

.15 CSA C22.2 No. 227.3, Mechanical Protection Tubing (MPT) and fittings (Tri-national standard with NMX-J-855-ANCE and UL-1696).

.16 CSA C22.2 No. 327, HDPE conduit, conductors-in-conduit, and fittings.

1.3 Submittals

.1 Submit product data in accordance with Division 1 and Division 26.

.1 Include certifications to appliable standards, ratings, and manufacturer specific installation requirements.

.2 Electric metallic tubing.

.3 Rigid aluminum conduit.

.4 Rigid PVC conduit.

.5 Flexible metal, liquid tight conduit.

.6 Flexible non-metallic, liquid tight conduit

.7 Conduit fittings, conduit couplings.

.8 Hazardous area sealing fittings, coupling and sealing compound.

.9 Conduit clamps and support systems.

.10 Submit information on where each type of conduit will be installed, prior to installation.

.11 Submit details of the cUL approved fire stop assembly for approval prior to installation.

.2 The Drawings do not show every specific conduit run. Supply and install conduit, and support systems as required for a complete installation.

.3 The materials for each conduit must meet the requirements of the area. Some areas are wet, highly corrosive; other areas have chemicals which may adversely interact with specific materials. Care must be taken in making the proper conduit selection for the particular area.

.4 Design equipment anchorage and support system for vertical and lateral loading in accordance with the MBC.

.1 Submit written certification from a Professional Engineer licensed in the Province of Manitoba stating that support systems, anchorage, and equipment are structurally sound, and have been designed according to requirements of the MBC.

1.4 Coordination

.1 Coordinate with other work including wire and cable, boxes and fittings and panel work, as necessary to interface installation of conduit with other work.

.2 Coordinate installation of conduit in concrete with work specified in Division 3.

.1 Confirm size restrictions for concrete embedded conduit with structural engineer.

.3 Coordinate installation of conduit in masonry with work specified in Division 4.

.4 Coordinate installation of conduit which penetrates roof or waterproofing membranes with work specified in Division 7.

.1 Provide necessary flashing and pitchpockets, making watertight joints where conduit passes through roof or waterproofing membranes.

.5 Coordinate installation of conduit which penetrates fire rated walls, floors or ceilings with firestopping work specified in Division 1. Ensure that integrity of the fire rated element is maintained.

1.5 Quality Assurance

.1 Electrical equipment and materials shall be new and comply with the latest codes and standards. Unless otherwise called out in the drawings, no used, re-built, refurbished and/or re-manufactured electrical equipment or materials shall be furnished on this project.

.2 Coated type conduits shall be prepared/repaired with cleaner, primer, and touch-up compound as per the manufacturers requirements.

.3 Installed conduit shall be free from dents, bruises and other damage.

1.6 Delivery, Storage and Handling

.1 Storage: Whenever possible, store the conduit indoors to prevent possible discoloration, the accumulation of dirt and to extend the life of the product. However, if conduit is stored outdoors, it should be stored in such a way as to allow air circulation and water to drain-off and shall not be directly covered in plastic.

2. PRODUCTS

2.1 Conduits and Minimum requirements

.1 Special attention to the selection of materials must take place in corrosive atmospheres where chemicals are stored, or chemical vapours may be present. Some processes utilize several different chemical types all with difference corrosive properties, if unsure of the material required for a chemical room or injection point request clarification from the Contract Administrator.

.2 Further application specific materials use have been provided throughout this document that cover a variety of rooms, areas, interior, exterior and a variety of installation types. If unsure of the material required for a specific area or installation request clarification from the Contract Administrator.

.3 Epoxy coated Conduit.

.1 Epoxy coated metal conduit is intended for hazardous areas above and below grade. The preferred metal is rigid threaded aluminum.

.2 CSA C22.2 No. 45.1, with zinc coated metal, with additional corrosion resistant epoxy finish inside and outside.

.3 CSA C22.2 No. 211.3 for rigid fibreglass reinforced epoxy conduit and associated fittings.

.4 PVC coated metal Conduit.

.1 PVC coated metal conduit is intended for hazardous areas above and below grade. The preferred metal is rigid threaded aluminum.

.2 CSA C22.2 No. 45.1, with zinc coated metal, with additional PVC coating.

.5 Rigid Aluminum, Red Brass, or Stainless Steel metal Conduit.

.1 For interior exposed applications, above grade. Rigid aluminum may be used in hazardous areas.

.2 CSA C22.2 No. 45.2, with factory applied, closed-end thread protectors.

.3 Rigid Aluminum shall meet a minimum alloy composition of Type AA6063.

.6 Flexible metal Conduit.

.1 Intended for connections to vibrating equipment, the flexible conduit is a short length with a connection between a permanent conduit system and the equipment. Also intended for connections to instruments where periodic inspection/adjustments/ calibrations may be required.

.2 CSA C22.2 No. 56, aluminum liquid-tight flexible metal.

.3 Flexible Metal Conduit: spirally wound, interlocked zinc coated strip steel, minimum 10 mm diameter.

.4 Liquid-Tight Flexible Metal Conduit: continuous interlocked and double-wrapped steel, zinc coated inside and outside, coated with liquid-tight jacket of flexible PVC, minimum 12 mm diameter.

.5 Liquid-Tight Flexible Metal Conduit Fittings: cadmium plated, malleable iron fittings with compression type steel ferrule and neoprene gasket sealing rings.

.7 Flexible non-metal Conduit:

.1 Intended for connections to vibrating equipment, the flexible conduit is a short length with a connection between a permanent conduit system and the equipment. Also intended for connections to instruments where periodic inspection/adjustments/ calibrations may be required.

.2 CSA C22.2 No. 227.3, heavy duty, liquid tight, PVC.

.8 Galvanized-Steel Rigid Conduit:

.1 For exposed outdoor application above grade, or interior dry areas.

.2 CSA-C22.2 NO. 45.1 and ANSI C80.1, zinc coating steel.

.9 High Density Polyethylene (HDPE):

.1 Direct burial and horizontal directional drilling conduit applications. Used where specifically approved by the Contract Administrator.

.2 CSA C22.2 No. 327 testing requirements, for direct burial or encasement in concrete or masonry in ordinary (non-hazardous) locations.

.10 Rigid Polyvinyl Chloride (RPVC) Conduit:

.1 RPVC for interior exposed (wet or wet corrosive atmospheres) and outdoor direct burial applications. Used in above ground general location applications when embedded in concrete walls, ceilings, or floors.

.2 DB2 may be used for direct burial, and concrete encasement applications.

.3 CSA C22.2. No. 211.0 testing requirements.

.4 CSA C22.2 No. 211.1:

.1 Rigid Type EB1 PVC conduit: for encasement in masonry and concrete only.

.2 Rigid Type DB2/ES2 PVC Conduit: for direct burial and/or encasement in masonry and concrete.

.5 CSA C22.2 No. 211.2 for unplasticized conduit.

.1 Rated FT-4 for conduits trade sizes between ½" through to 6" when used in interior applications, and suitable for direct burial.

.11 Reinforced Thermosetting Resin Conduit (RTRC):

.1 For encased burial, or direct burial applications.

.2 CSA C22.2 No. 211.3

.12 Electrical Metallic Tubing (EMT):

.1 Used in lunch rooms and office spaces.

.2 EMT: to CSA C22.2 No.83

.13 Mechanical Protection of direct burial conductors, as permitted under CEC 12-012(3)(e):

.1 Polyethylene Pipe: to CSA B137.1, minimum series 75.

.2 Flexible Plastic Underground Power Cable Ducting: to CSA C22.2 No. 211.1

2.2 Conduit Fastenings

.1 One hole stainless steel straps to secure surface conduits 50 mm and smaller.

.1 Two hole stainless steel straps for conduits larger than 50 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits at 1 m on centre.

.4 Strap material to match conduit material.

.5 Set screw fittings are not permitted.

.6 Threaded stainless steel rods, minimum 10 mm diameter, to support suspended channels.

2.3 Conduit Spacers

.1 PVC coated malleable metal spacers, CSA approved for the purpose.

.2 Aluminum channel may be utilized where conduits are grouped; however, a non-metallic spacer must be provided between the aluminum channel and concrete.

2.4 Conduit Fittings

.1 Fittings manufactured for use with conduit specified, CSA certified, and environmentally rated for the intended area of use.

.1 Miscellaneous Fittings: locknuts, bushings, reducers, chase nipples, 3 piece unions, split couplings, plugs, and expansion fittings specifically designed for their particular application.

.2 Coating: same as conduit.

.3 Hazardous Locations: All fittings, couplings and devices shall be rated for the Hazardous Classification(s).

.2 Utilize factory made elbows for 27mm and larger conduits.

.3 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.

.4 Flexible Metal Conduit Fittings: threadless hinged clamp type.

.5 Electrical Metallic Tubing (EMT):

.1 Fitting Material for 25 mm size Conduit and Smaller: zinc alloy or zinc coated steel.

.2 Fitting Material for Conduit Larger than 25 mm Size: zinc coated steel.

.3 Type: compression or set screw, liquid tight for wet or damp areas.

.6 Flexible metal, liquid-tight conduit:

.1 Metal insulated throat connectors with integral nylon or plastic bushing rated for 105°C.

.2 Insulated throat and sealing O-rings.

.1 Manufacturers and Products – General Locations

.1 ABB (Thomas & Betts); Series 5331.

.2 Manufacturers and Products – Hazardous Locations

.1 Emerson (O-Z/Gedney); Series 4Q.

.7 Flexible, non-metallic, 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 Emerson (O-Z/Gedney); Type STN/LM/NM.

.2 ABB (Thomas & Betts); Series 6300

.3 Carlon; Type LT.

.8 PVC type:

.1 Meet requirements of NEMA TC-3.

.2 Type: PVC, slip-on.

2.5 Expansion Fittings for Rigid Conduit

.1 All conduits entering outlet boxes and devices that are located in walls subject to movement shall be terminated by means of liquid-tight flexible conduit, approximately 450 mm in length between the conduit and the outlet box or device which is being supplied. All conduits, bus duct, wireways, etc., passing through or across expansion joints of the building shall be installed with the use of approved expansion fittings.

.2 There are structural expansion joints in the facilities – these are not specifically identified on the electrical Drawings. Review the structural Drawings and note the locations of all expansion joints. Provide expansion couplings and fittings for all conduit crossing the joints. Do not locate rigid devices (for example panels) across or on top of the expansion joints. Add expansion fittings as required to accommodate expansion joints due to temperature variations.

.3 Expansion Fitting Manufacturers and Products:

.1 Deflection/Expansion Movement – General Locations:

.1 Emerson (Appleton) type DX.

.2 Eaton (Crouse-Hinds) type XD.

.2 Expansion Movement Only – General Locations:

.1 Emerson (Appleton) type XJ.

.2 Eaton (Crouse-Hinds) type XJ.

2.6 Fish Cord

.1 Polypropylene.

2.7 Conduit Bonding

.1 All conduits shall have a bare or insulated copper bonding conductor run within. The bonding conductor shall be sized as per the CEC, table 16. The conduit itself cannot be used as the only means of bonding. Provide bond jumpers between conduit systems, and to the bond terminals on pull boxes and junctions boxes to ensure electrical continuity of all conduit systems. Not all bond cables are shown on the Drawings or on the cables list. Provide bonds even though not explicitly indicated in other documentation.

.2 Utilize insulated grounding bushings / conduit hub at all enclosure entries for metallic conduit.

.1 Material: Cast aluminum, with integral insulated throat, rated for 150°C.

.2 Manufacturers and Products – General Locations

.1 ABB (Thomas & Betts) Series 370AL.

.2 Emerson (O-Z/Gedney) Type AB.

.3 Emerson (O-Z/Gedney) Type ABLG

.3 Manufacturers and Products – Hazardous Locations:

.1 Emerson (O-Z/Gedney) Type HUBG.

.2 Eaton (Meyers; Crouse-Hinds) Series STGK/SSTGK.

3. EXECUTION

3.1 Routing

.1 Locate conduits containing communication and low voltage conductors away from conduits containing power wiring.

.2 Run parallel or perpendicular to building lines. Follow structural surface contours when installing exposed raceways. Avoid obstruction of passageways.

.3 Do not pass conduits through structural members except as specified on the Drawings, or as permitted by the Contract Administrator.

.4 Route conduits on suspended channels where possible.

.5 Avoid routes that would interfere with any potential maintenance activities.

.6 Where not specifically shown in detail on the Drawings, review proposed conduit routing with Contract Administrator prior to installation. Comply with all routing changes requested by the Contract Administrator.

.7 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

3.2 Spacing and Supports

.1 Wall spacing:

.1 Group conduits wherever possible on suspended or surface mounted channels.

.2 Install spacers as required to provide a space between the conduits and the supporting surface, with a minimum space as follows:

.1 Above grade spaces not classified as CEC Category 1 or 2:

.1 Drywall / wood surfaces: no space required.

.2 Masonry / concrete surfaces: 6 mm.

.3 Below grade spaces: 12 mm.

.2 Wet locations: 12 mm.

.2 Supports for metallic conduit:

.1 Maximum spacing between supports for metallic conduit:

.1 16 mm conduit: 1.0 m.

.2 21 mm conduit: 1.5 m.

.3 27 mm conduit 1.5 m.

.4 35 mm conduit 2.0 m.

.5 41 mm conduit and larger 2.5 m.

.3 Supports for PVC conduit:

.1 Maximum spacing between supports for rigid PVC conduit:

.1 21 mm conduit 0.75 m.

.2 27 mm conduit 0.75 m.

.3 35 mm conduit 0.75 m.

.4 41 mm conduit 1.2 m.

.5 53 mm conduit 1.5 m.

.6 63 mm conduit 1.5 m.

.7 78 mm conduit 1.5 m.

.8 91 mm conduit and larger 2.0 m.

3.3 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 Wet or corrosive areas: flexible, non-metallic liquid tight conduit.

.2 Dry and non-corrosive areas: flexible, metallic liquid tight conduit.

.3 Hazardous areas: flexible liquid tight conduit, with couplings and fittings suitable for Class I, Division 1 and 2 areas.

.4 Length: 450 mm minimum, 1500 mm maximum, sufficient to allow movement and adjustment of equipment.

.2 Luminaires in dry areas: flexible, metallic liquid-tight conduit or approved cabling.

.3 Transition from underground or concrete embedded to exposed: rigid PVC to rigid aluminum conduit.

.4 Exterior light pole foundations: rigid PVC conduit.

3.4 Bends

.1 Conduit runs shall not exceed four 90 degrees bends (for a total of 360 degrees) between pullboxes.

.2 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter. Bends are to be symmetrical.

.3 Avoid field-made bends and offsets, but where necessary, make with an acceptable bending machine. Do not heat metal raceways to facilitate bending.

.4 Make bends in parallel or banked runs from same center or centerline with same radius so that bends are parallel.

.5 Factory elbows may be installed in parallel or banked raceways if there is change in plane of run, and raceways are same size.

.6 Use factory made elbows for conduits over 27 mm in diameter.

.7 Install concealed raceways with a minimum of bends in the shortest practical distance.

.8 PVC Conduit:

.1 Bends 30 degrees and larger: provide factory made elbows.

.2 Use Manufacturer's recommended method for forming bends.

.9 Do not make bends that exceed allowable conductor or cable bending radius; or that significantly restrict cable pulls.

3.5 Penetrations

.1 Prior to coring, drilling or cutting through wall, roof or floor members: perform scan of the surface, mark the intended location, and confirm acceptability with the Contract Administrator.

.2 For circular penetrations, provided steel pipe (galvanized or stainless to suit the environment).

.3 Provide 88.9 mm high concrete curb around floor penetrations that are subject to regular clean up or wash down.

.4 Make at right angles, unless otherwise shown.

.5 Notching or penetration of structural members, including footings and beams, is not permitted unless specifically approved by the Contract Administrator.

.6 Firestop openings around penetrations to maintain fire-resistance rating.

.7 Apply single layer of wraparound duct band to all metallic conduit protruding through concrete floor slabs to a point 50 mm above and 50 mm below concrete surface.

.8 Concrete walls, floors, or ceilings (above ground): provide non-shrink grout dry-pack, or use watertight seal device.

.9 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 Exterior wall penetration:

.1 Utilize Roxtec weatherproof sealing system.

.2 Install to Manufacturer's recommendations.

.3 Install flush with exterior of the wall.

.4 Prior to installation of seals, Contractor to submit proof of training to the Contract Administrator. Do not install the cable seal system without equipment Manufacturer training, as work will have to be re-done. Contact Roxtec for training.

.5 Prior to covering up wall penetration work, arrange for a site inspection of the work with the Contract Administrator. Proof of proper installation is required.

.3 Concrete roof or membrane waterproofed 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 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.

.4 Heating, ventilating, and air conditioning equipment:

.1 Penetrate equipment in area established by Manufacturer.

.2 Connect equipment using liquid tight flexible conduit.

.5 Corrosive sensitive Areas:

.1 Seal all conduit passing through corrosive room walls.

.2 Seal conduit entering equipment panel boards and field panels containing electrical equipment.

.6 Existing or precast wall (underground): core drill wall and install a watertight entrance seal device.

.7 Nonwaterproofed floor (underground, without concrete encasement):

.1 Provide watertight entrance seal device.

.2 Fill space between raceway and sleeve with expandable watertight compound or oakum and lead joint, on each side.

.8 For exterior installations, conduit entry shall be from the bottom, unless approved otherwise by the Contract Administrator.

3.6 Installation - General

.1 Provide bonding conductor in all conduit systems. Verify bond continuity of all conduit systems.

.2 Install conduit concealed, in walls, floors, ceilings, above suspended ceilings, and underground.

.1 Unless otherwise indicated, install conduits surface-mounted on walls and ceilings. Conceal or embed conduits only where indicated.

.2 Install concealed, embedded, and buried raceways so that they emerge at right angles to surface and have no curved portion exposed.

.3 Conduits shall be sized in accordance with CEC requirements for wire counts installed. Conductors shall be de-rated according to code requirements. Upsize conductors as required to meet CEC and voltage drop requirements.

.1 Except where otherwise required by Canadian Electrical Code (CEC), provide conduit of types specified and sizes indicated on drawings or as specified.

.2 Where sizes are not indicated, select proper sizes to suit intended use, fulfill wiring requirements, and comply with Canadian Electrical Code (CEC).

.3 Minimum conduit size: 21 mm, unless specifically indicated otherwise on the Drawings or specifically approved by the Contract Administrator.

.4 Water/Wastewater Treatment Plant – Conduit Types by Area:

.1 Office, lunch room, and similar dry locations:

.1 EMT conduit.

.2 Chemical Rooms, Corrosive Areas (Category 2):

.1 RPVC conduit.

.3 Hazardous Locations/Areas, and Corrosive Areas:

.1 Underground, and/or in concrete.

.1 Epoxy coated metal conduit (i.e. green-guard or other product type).

.2 PVC coated metal conduit.

.2 Above-grade installations:

.1 Exposed above-grade conduits shall be rigid aluminum, liquid tight, and as required to meet the requirements of the installation. Do not use steel conduit for areas where H2S gas or other corrosive gasses or liquids are present.

.3 Use explosion proof flexible connection for connection to explosion proof motors.

.4 Install conduit sealing fittings, fill with sealing compound and fiber material. Meet all requirements of the CEC with respect to hazardous areas sealing and means and methods. Refer to CEC Section 18 and 22 for additional requirements.

.4 General Locations/Areas and Category 1 (wet), and Heat Trace Systems:

.1 Rigid Aluminum threaded conduit.

.5 General Locations/Areas and dry:

.1 Rigid Galvanized Steel conduit.

.6 Exterior and Outside, Above-grade installations:

.1 Rigid Galvanized Steel conduit.

.5 Where EMT and PVC conduit is used, provide a separate green insulated ground wire in each conduit.

.6 Use liquid tight flexible metal conduit for connection to motors/pumps, vibrating equipment, instrumentation, and luminaries.

.7 Plug conduit ends to prevent entry of dirt and moisture.

.8 Seal conduit with duct seal compound and fibreglass insulation where conduit leaves heated area and enters unheated area.

.9 Field threads on rigid conduit must be of sufficient length to draw conduits up tight and to the minimum fully engaged threads per the CEC for application and Hazardous area.

.10 Install pull cord in all empty conduits.

.11 Emergency lighting and exit signs shall be connected via a separate and dedicated conduit system.

.12 Remove and replace blocked conduit sections.

.1 Do not use liquids to clean out conduits.

.13 Dry conduits out before installing wire.

.14 All conduits exposed in finished areas are to be free of unnecessary labels and trade marks.

.15 Seal and firestop penetration around conduit with cUL approved fire stop assembly for the installation conditions.

.16 Where conduit crosses building expansion joints, install expansion fitting approved by Authority Having Jurisdiction, complete with grounding jumper. Provide bend or offset in conduit adjacent to building expansion joint where conduit is installed above suspended ceilings.

3.7 Installations in Category 1 Locations

.1 Arrange to provide drainage at frequent intervals to suitable locations.

.2 Equip with approved fittings to permit the moisture to drain out of the system.

.3 Install the conduit with a minimum of 12 mm space from the supporting surface.

.4 Every joint, coupling and fitting to be water-tight.

.5 Where conduit leaves a warm room and enters a cooler atmosphere, seal the conduit and arrange the conduit in a manner to avoid condensation accumulation at the seal.

3.8 Installations in Category 2 Locations

.1 Comply with all requirements of Category 1 locations.

3.9 Installations in Category 2 Wet Locations

.1 Comply with all requirements of Category 1 locations.

3.10 Installations in Hazardous Locations

.1 Install conduit system, complete with explosion proof conduit sealing fittings:

.1 Install cables in conduit system – maximum permitted conduit / conduit fitting fill for hazardous areas is 25%.

.2 Provide sealing fittings to suit the area classification, and to meet the CEC requirements.

.3 Install sealing compound following Manufacturer's instructions.

3.11 Installation – Metal Conduit and Tubing, Rigid Metal Conduit

.1 Field-bend conduit with benders designed for purpose so as not to distort nor vary internal diameter.

.2 Avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat surfaces with corrosion inhibiting compound before assembling.

.3 Utilize insulated grounding bushings at all enclosure entries for metallic conduit.

.4 Cut conduit straight with a squared end, properly ream smooth, cut threads and brush threads clean.

.1 Remove burrs, ream and clean metal conduit before installation of conductors, wires, or cables.

.2 Metal, threaded conduit to be cut with a cutting tools that provide a 19mm taper per foot.

.5 Fasten conduit terminations in sheet metal enclosures with two locknuts and terminate with bushing. Install locknuts inside and outside enclosure.

.6 Conduit installed underground shall be painted with two coats of corrosion inhibiting compound before backfilling.

.7 Threaded conduit connections shall have a minimum of 5 full threads fully engaged or greater. In general all threaded connections (for both hazardous and non-hazardous areas) shall meet or exceed the requirements set out in CEC Section 18.

.8 Provide drain seal in vertical raceways where condensate may collect above sealing fitting.

3.12 Installation – Non-Metallic Conduit

.1 Make field bends and solvent cemented joints in accordance with manufacturer's instructions.

.2 PVC conduit sections and fittings shall be connected using watertight PVC conduit cement.

3.13 Installation – Exposed/Surface and Semi-Concealed Conduit

.1 Run conduits adjacent to or below existing cable tray systems. Use existing strut where available, add strut and threaded rod where existing strut is not available.

.1 Group conduits wherever possible on suspended or surface mounted unistrut channels.

.2 Where conduits pass through walls, group and install through openings. After all required conduits are installed; close wall openings with material compatible with the wall construction. Perform fire stopping & sealing to ensure integrity of wall.

.3 Provide a minimum of 1 conduit diameter of space between adjacent conduit runs.

.2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

.3 Install conduit to conserve headroom and cause minimum interference in spaces through which conduit passes.

.4 Install conduit so as not to interfere with ceiling inserts, luminaires or ventilation ducts or outlets.

.5 Alter routing to avoid structural obstructions, keeping crossovers to a minimum.

.6 Install exposed conduit and extensions from concealed conduit systems neatly, parallel with, or at right angles (perpendicular) to walls and structural members.

.7 Run conduit for outlets on waterproof walls exposed. Set anchors for supporting conduit on waterproof wall in waterproof cement.

.8 Run conduits in flanged portion of structural steel.

.9 Do not pass conduits through structural members except as indicated. Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.14 Installation - Concealed Conduits

.1 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.

.2 Where required to be concealed, install conduit neatly and close to building structure so as to minimize need for furring.

.3 Run parallel or perpendicular to building lines.

.4 Do not install horizontal runs in masonry walls.

.5 Do not install conduits in terrazzo or concrete toppings.

3.15 Installation - Conduits in Cast-In-Place Concrete (On Grade)

.1 Place conduit between bottom reinforcing steel and top reinforcing steel.

.1 Install in centre one third of slab.

.2 Ensure minimum 20 mm concrete cover.

.2 Separate conduit by not less than diameter of largest conduit to ensure proper concrete bond.

.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.

.1 Use cold mastic between sleeve and conduit.

.6 Conduits in slabs: minimum slab thickness 4 times conduit diameter.

.7 Encase conduits completely in concrete with minimum 25 mm concrete cover.

.8 Organize conduits in slab to minimize cross-overs.

3.16 Installation - Conduits in Cast-In-Place Slabs (Below Grade)

.1 Use epoxy coated rigid steel conduits.

.2 Run conduits 25 mm and larger below slab and encase in 75 mm concrete envelope.

.1 Provide 50 mm of sand over concrete envelope below floor slab.

3.17 Installation - Conduits Underground

.1 Minimum burial depths shall be as detailed on the Drawings, but in no case less than the requirements indicated in the CEC.

.2 Conduits shall have a red plastic warning tape placed above, buried at a depth of 305 mm below grade. The plastic tape is to completely cover all conduits, and overlap the width of all conduits by at least 150 mm on either side. Provide mechanical protection, planking in accordance with the U.G trenching specifications.

.3 All underground direct buried conduits shall be rigid PVC.

.4 Provide rigid PVC conduit, type DB2 for encasement in concrete for duct banks. HDPE conduit can be used only where specifically approved by the Contract Administrator.

.5 Maintain a minimum of 1200 mm horizontal clearance distance from underground structures such as buildings and equipment foundations.

.6 Maintain a minimum of 600 mm horizontal clearance distance from underground equipment such as piping and other underground conduit runs.

.7 All clearances in strict accordance with the MBC, CEC, and all other bylaws.

.8 Provide Universal GPS coordinates of all underground conduit runs at every bend, and at every 6000 mm intervals. Include coordinates on the As-Built Drawings.

.9 Provide man-holes and hand-holes as required to accommodate the conductor pull.

.10 Slope conduits away from building and enclosures entry points, to provide drainage.

.11 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

END OF SECTION

CABLE TRAYS FOR ELECTRICAL SYSTEMS

1. GENERAL

1.1 Description

.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section. This section supplements requirements of other Divisions.

.1 Section includes cable tray, cable tray accessories, hangers and supports that may be required for the project and the applications where each type shall be used.

.2 Provide a complete system of cable trays required to fully support all cable and conduit throughout the facility. System shall provide separate trays or barriers for 600 VAC systems, 120 VAC systems, and 24 VDC systems. System shall be complete with all supports and hangers as necessary for the installation.

.1 Where medium voltage (4.16kV and 12.47kV) power cables are either required or are existing these tray systems shall be kept separate.

.3 Coordinate the location of the support channels so as not to interfere with other services.

.4 Not all cable tray required is indicated on the Drawings. Provide additional tray as required to fully support all cable and conduit throughout the facility as required under this Contract.

1.2 References

.1 ASTM International (ASTM):

.1 A123/A123M: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.2 B633: Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

.3 B766: Standard Specification for Electrodeposited Coatings of Cadmium.

.2 Canadian Standards Association (CSA):

.1 C22.1: Canadian Electrical Code Part I (CEC) as amended by provincial, territorial or municipal authority having jurisdiction. References to CEC/MEC elsewhere in this document shall include reference to such amendments.

.2 C22.2 No. 126.1 - Metal Cable Tray Systems.

.3 C22.2 No. 126.2 - Non-metallic Cable Tray Systems.

.4 HA Series M - CSA Standards for Aluminum and Aluminum Alloys.

.3 National Electrical Manufacturers Association (NEMA):

.1 VE 1 – Cable Tray.

.2 VE 2 – Cable Tray Installation Guidelines.

.3 RV 4 – Application and Installation Guidelines for Service-Entrance Cable.

.4 Manitoba Electrical Code (MEC):

.1 Manitoba amendments to the Canadian Electrical Code.

.5 Underwriters Laboratories (UL):

.1 CAN/ULC-S115, Standard method of fire tests of firestop systems.

1.3 Shop Drawings and Product Data

.1 Submit Shop Drawings and Product data in accordance with Division 1 and Division 26.

.1 Manufacturer's descriptive literature for materials.

.2 Prior to construction, submit design drawings and calculations indicating all tray loading has been reviewed by and bear the stamp of a Professional Engineer registered in the Province of Manitoba.

.3 Literature includes dimensions, misc. materials, finishes, certifications, load ratings, fire stopping systems including cUL/CSA listing and certifications, anchor and connection details, and structural dimensions and materials.

.4 Design drawings shall include but not limited to:

.1 Indicate the various types of cable trays used.

.2 Show actual cable tray installation details and suspension system.

.3 Arrangement and dimensions of mounting fittings and accessories

.4 Detailed layout plans indicating cable tray locations, sizes, barriers, and structural supports.

.5 Indicate bills of materials for the complete system, including quantities of each tray members.

.5 Design, plan and coordinate cable tray routing to avoid conflicts with other trades. Install trays and raceways generally as indicated on the Drawings. Coordinate this Work with the other trades to ensure adequate horizontal and vertical clearances are maintained.

.1 Cable tray and channel to be suspended at an elevation that will not interfere with other systems – such as lighting, mechanical systems, piping, building structure, etc.

.2 Lighting fixtures shall be mounted adjacent to cable tray systems (i.e. same height), or below. Light fixtures mounted over-top cable tray systems is not acceptable.

.3 Provide additional offsets, bends, etc. as required to adjust cable tray routing and height to avoid conflict with ducts, pipes, beams, etc. Provide 45 degree risers over

or under architectural, mechanical or structural systems where required. Confirm requirements on site and include costs in tender price.

.4 Do not install tray routes and tray supports until the desired routing have been coordinated with other trades. Inform the Contract Administrator of any conflicts and make adjustments as determined by the Contract Administrator.

.6 Testing:

.1 Factory certified test reports of specified products, conforming to CSA C22.2 No. 126.1 and related NEMA standards.

.2 Field test reports indicating and interpreting test results relative to compliance with performance requirements.

.2 Acceptable Manufacturers:

.1 Unitray Systems Inc.

.2 ABB (Thomas & Betts) B-Line Series.

.3 Eaton B-Line Series.

.4 MP Husky Cable Tray & Cable Bus.

.5 Canadian Electrical Raceways Inc (CER).

.6 Enduro Systems, Inc.

.7 Or approved equivalent.

1.4 O&M Manual

.1 Include all Shop Drawings and product submittals.

1.5 Coordination

.1 For cable tray installation coordinate pathways and installations supports with structural work and mechanical ductwork.

.2 Do not support cable tray from other division structural supports without permission from structural engineer.

.3 All trays are shown diagrammatically on the Drawings. Determine the exact location in the field. Install tray runs to prevent interference with process or service piping and ducting and to maintain clearance for tray access. Coordinate the exact location of tray supports and runs with the work of other Divisions.

2. PRODUCTS

2.1 Cable Tray

.1 Use aluminum tray unless indicated on the drawings. Select the Class of Tray based on the methods of cable tray support. Cable tray shall conform to CSA C22.2 No. 126.1 with 228 mm (9") rung spacing, 150 mm (6") side rails and width as required to prevent cable and tray de-rating. The Contractor is responsible for increasing cable sizes due to de-rating factors from cable spacing.

.1 Aluminum ladder type in most areas.

.2 For specific locations where chemical corrosion is a concern (i.e. Chemical Rooms), use 316 Stainless steel tray.

.2 Factory manufactured horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints, reducers and other fittings where required. Field fabricate only those fittings not available from Manufacturer. All direction changes in main runs of cable tray shall be made using standard factory-made fittings.

.1 Radii on fittings: 600mm minimum, provide Radaii to accommodate the cabling requirements and installation. Minimum cable and channel tray fitting radius shall meet or exceed the minimum bending radius of the cables installed.

.3 Provide stainless steel rod hanger clamps, rod hangers, wall mounting support brackets and all necessary accessories for complete installation.

.4 Barriers where different voltage systems or electrical systems are in the same tray, or as indicated.

.1 Provide barrier to separate 600 V power and control cables from analogue cables when these cables are installed in the same cable tray.

.2 Provide separate cable tray for medium voltage (4.16 kV and 12.47 kV) power cables.

.3 Fire Barriers in accordance with Division 1 and Division 26.

.5 Cable tray covers shall be solid aluminum covers with a flange and complete with raised cover clips.

.1 Install cable tray cover were mechanical protection of cables is required and all external/outdoor installations. Where covers are required in only the vertical plane these shall be provided to a minimum height of 3 m above grade.

.2 Install covers on trays crossing under open stairways and grating, and for 2 m above floor penetrations.

.6 Cable Spacers:

.1 Recommend suitable space in accordance with manufacturers requirements if spacers are required.

.2 Diameter of opening to be suitable for cable size.

.3 Mounting hardware to be compatible with tray system.

.4 Multi conductor cable feeders to be tied down with adequate tie raps.

.7 Unless otherwise approved by the Contract Administrator, provide cable trays of the same manufacturer throughout the Work.

2.2 Supports

.1 Coordinate with structural system and with other electrical installations, the building manufacturer, or structural engineer. Installations shall only commence after confirming the anticipated weight and attachment locations have been coordinated with the building manufacturer, or structural engineer.

.2 Provide aluminum support members for aluminum cable tray. Provide 316 Stainless steel support members for stainless steel cable tray.

.1 Provide stainless steel rod hangers, washers, bolts, nuts, fittings, rod hanger clamps and accessories as required. Minimum Stainless Steel type AISI 304. Provide all fixing hardware, support hardware, clams and accessories as required.

.3 Design and install the cable tray / cable channel support system suitable for the tray / channel loading class.

.4 Suspend cable trays on rod hangers and hanger clamps or channels spaced as required by loading classification rating and not more than the maximum support spacing on centers as per the Span/Load Class requirements. Fasten hangers to channels securely mounted to the structure. Typical maximum support spacing have been provided Table below from CSA C22.2 No.126. Supports shall be provided as required for the Class, the installation means and methods employed, and all cable tray bends.

.1 CSA class loading as a minimum, must safely handle the weight of the cables installed, must anticipate the weight of approximately 20% future cabling, plus a safety factor. Safety factor on NEMA tray systems is 1.5, and 1.7 for IEC tray systems.

Class	Design Load (kg/m)	Maximum Design Support Spacing (Straight Length) (m)
A	37 kg/m (24.86 lb/ft)	3m
C1	97 kg/m (65.18 lb/ft)	3m
D1	67 kg/m (45 lb/ft)	6m
E	112 kg/m (75.26 lb/ft)	6m

.5 Fitting supports: All fittings have their own support requirements, refer to NEMA VE2 and the manufacturers literature. Supports shall be selected, designed and installed to accommodate a minimum of three (3) times the tray loading class weight.

.1 Cable tray fittings, expansion joints and the like shall be supported within 600 mm of both sides of such connection. Locate splice plates within 600 mm of a support.

.6 Wall mounted support brackets: Provide aluminum channel strut supports mounted vertically in concrete wall complete with mounting brackets sized to suit cable tray width and loading. Use approved anchor bolts for fastening brackets.

.1 Where a cable tray support is installed at a location greater than 1000 mm from a structural column, the horizontal strut of the cable tray support shall be supported by two structural steel members.

.7 Vertical cable trays shall have cable tray supports spaced at intervals not exceeding 1200 mm and shall be open on one side to facilitate cable pulling.

.8 Supply and install all other tray manufacturer approved accessories, including cantruss guide clamps, support brackets, etc. Provide and install stiffener bars as required.

.9 Where supports cannot be installed due to lack of suitable structural members, the contractor will use longer lengths of cable tray to span between the available structural supports.

.1 This may require the cable tray classification to be adjusted (increased).

.2 This may require Unistrut or other suitable structural means to span across the structural members (typically spanned and fastened between two or more purlins, or joists).

.3 This may require floor Unistrut floor supports in areas where existing HVAC or other large equipment may impede a section of ceiling space. The floor supports shall not interfere with the rules of egress or required working space around equipment.

2.3 Expansion Joints

.1 There are structural expansion joints in the Facility. Provide expansion couplings and fittings for all conduit, tray, etc. crossing the joints. Do not locate rigid devices (for example panels) across or on top of the expansion joints.

.2 The table has been provided as a minimum requirement for incorporation of expansion joints into the cable tray installation. Where the cable tray manufacturer has posted data indicating the expansion of their product may require additional gap, the more stringent shall apply.

.3 Use expansion-joint splice plates to allow 50 mm free movement between adjacent trays when crossing a building expansion joint.

.4 The table below is provides the Maximum spacing between Expansion Joints that provide for 250 mm (1") Movement.

.1 Where non-metallic tray is installed requiring 16 mm (5/8") movement, multiply maximum spacing between expansion joints by 0.625.

Application Type	Temp Differential* (˚C)	Steel		Alum		Fiberglass	
		(m)	(ft)	(m)	(ft)	(m)	(ft)
Indoor Installation	14	156	512	79	260	203	667
	28	78	256	40	130	102	333
	42	52	171	27	87	68	222
	56	39	128	20	65	51	167
Outdoor Installation	70	31	102	16	52	41	133
	83	26	85	13	43	34	111
	97	22	73	11	37	29	95
* Temperature Differential is the difference in temperature between the hottest and coldest days of the year.							

2.4 Cable Channel

.1 Ventilated trough type.

.2 Channel: Aluminum for process and office areas, with the exception of: use 316 stainless steel within the chemical building and for any exterior cable tray runs. Provide the required width and depth of channel to accommodate the required cabling.

.3 Cable channel bonds shall be a minimum #6 AWG, stranded, copper conductor connected to each section with a Manufacturer approved grounding/bonding lug, in accordance with CEC requirements. Upsize bond conductor to account for cable ampacity in accordance with CEC table 16.

3. EXECUTION

3.1 Installation

.1 Install in accordance with Manufacturer's requirements, in accordance with NEMA VE2, in accordance with the drawings, and as required by the Final Design. Install tray to be accessible at all locations.

.2 The Drawings indicate general concepts, and may not show all details required for mounting or installation. Supply and install any additional items required for a complete and working installation.

.1 Install cable tray of the size and type as specified on the Drawings and as required for cable routing. The Drawings show main cable tray routes only – they do not show all required cable channels to individual pieces of equipment. Provide cable channel (even though not explicitly shown on the Drawings) to route cables to specific equipment.

.2 Where a common tray is shown on Drawings, separate the cables for different voltage classes from each other by metal barriers as supplied by the tray Manufacturer.

.3 Provide a cable tray system for three (3) or more cables when cable lengths exceed 3 m.

.4 Size cable trays as indicated on Drawings and per the Cable Tray system design. If any discrepancies are found or changes in tray size are required, advise the Contract Administrator before installing the tray systems.

.5 The cable installation shall adhere to CEC requirements with respect to cable spacing and cable de-rating factors. De-rating shall be in accordance with CEC table 5C and 5D. Cables shall be installed uniformly across the width of the tray to minimize the number of layers and in accordance with CEC de-rating factor requirements.

.6 Provide minimum vertical clearance above the trays as per the CEC or as indicated on the Drawings.

.7 The installation shall be parallel or perpendicular to the building structure / grid lines and shall be installed straight, plumb and true unless otherwise shown on the Drawings. Where two or more trays run the same route, make parallel and ensure offsets and bends are uniform.

.3 Construct and use approved platforms, scaffolding and rigging systems for installation and access. The use of cable trays as walkways, "ladders", or structural rigging supports is not permitted.

.4 Maintain spacing between cables of different systems and voltages. Install barriers within cable trays to separate systems.

.5 Ensure that the cable / channel trays and supports are properly aligned with a minimum of distortion.

.6 Provide metal cable clamps (approved for use by the tray manufacturer) bolted to the side of the tray for all cables entering or exiting the cable tray.

.7 Cable tray sections shall be saw cut as required. Cut sections shall be square, de-burred, and drilled for standard factory splice plates. Cutting by welding or burning is not permitted.

.8 Do not allow or cause any work performed or installed to be covered up or enclosed prior to the required inspections, tests and approvals.

.9 Cables in Cable Tray:

.1 Install cables individually.

.2 Lay cables into cable tray to provide a minimum of cable crossovers.

.3 Secure cables in cable tray at 6 m centres with nylon ties.

.4 The air space between cables shall be 100% of the largest conductor diameter or unless otherwise specified. Provide a minimum of 20% space area in all cable tray systems.

.10 Suspend cable trays on rod hangers and hanger clamps or channels spaced as required by loading classification rating and spaced not more than the maximum allowed for the Tray

class, elbow, or fitting requirements on centers. Fasten hangers to channels securely mounted to the structure.

.1 Do not drill through wood ceiling trusses. Provide wood blocking on top of ceiling truss to anchor rod hangers and channels.

.2 Where hanger threaded rods are used, use stainless steel and not be smaller than 12 mm in diameter to trapeze style hangers. Trapeze style members shall be supported by a minimum of two (2) threaded rods, the member material shall match the supported Tray system, with a minimum member diameter of 41 mm x 41 mm.

.3 Where threaded rod does not line up with the structural attachment points above, provide strut to span between two or more purlins. Cantilevered strut is not acceptable.

.11 Provide minimum 600 mm horizontal clearance on one side of cable tray throughout.

.12 Install tray systems in such a manner as to conserve headroom and minimize the use of free space through which they pass. Maintain a minimum 2,100 mm clear headroom wherever possible.

.13 When the ends on square strut channel type shelf brackets are below 2100 mm AFF in a walking area, cut flush with tray. Permanently cap the end of square strut channels, etc. with plastic caps. Suitably protect sharp corners and edges of tray to prevent personal hazard.

.14 Provide a green PVC-insulated bonding conductor of 4/0 AWG stranded tin plated copper on tray throughout the entire length of each tray run. Attach bonding conductor to tray at minimum every 15 m with approved ground wire clamps and anti-oxidizing compound, and at each isolated segments of tray (i.e. separate joints, fittings, tray sections etc.). Bonding conductor insulation to be FT4 rated for indoors and FT1 rated for outdoors. For trays stacked vertically above each other (maximum of three trays in stack), provide a bonding conductor throughout the entire length of one tray with bonding jumpers at a minimum of every 15 m from that tray to the other tray(s) in the tray stack, and at each isolated segments of tray. Solidly connect each tray run to the electrical room ground bus.

.1 All cable tray sections shall be bonded, using the building frame as a path to ground is unacceptable.

.2 For tray installed in hazardous areas, wet or corrosive areas: green insulated jacket.

.3 For trays installed in dry, non-corrosive, non-hazardous areas: bare copper.

.4 Supply and install tray manufacturer approved ground wire clamps for ground wire connection onto tray members.

.15 Check all trays for surface smoothness prior to installation and remove all debris, burrs, ridges, foreign material etc. on all tray surfaces facing or in contact with the cabling. Remove sharp edges. Cut ends or defaced surfaces shall be painted or as directed by the Contract Administrator.

.16 Repair or restore to original condition, any equipment or structure damaged during installation or before final acceptance at no additional cost.

.17 Restore to original condition any painted surfaces damaged during installation at no additional cost.

3.2 Barriers and Separations

.1 Provide barriers where different low voltage systems (600V and lower) are in same cable tray, and separation when entering or leaving the tray system. Cables shall be spaced in accordance with the following table from the City of Winnipeg's Electrical Design Guide.

.2 Supply and install tray manufacturer approved conduit to cable tray adapters for transitions from a conduit system onto the tray.

Cable	**Other Cable**	**Minimum Segregation**	**Notes**
Communication – Fibre	Communication	None	
	Instrumentation / Control < 50 V	None	
	Other	Separate Raceway	To reduce risk of physical damage to fibre cable.
Communication – Copper	Instrumentation / Control < 50 V	50 mm	
	120 VAC, 8 AWG or smaller	100 mm	
	120 VAC, > 8 AWG	300 mm	
	600 VAC Power	300 mm	
	VFD or other high harmonic cable	300 mm	Metallic conduit
		600 mm	Other raceway
	Medium Voltage – 3C armoured and shielded	300 mm	May be in metallic conduit instead of armoured.
	Medium Voltage – 1C or 3C unshielded	450 mm	
Instrumentation (Analog)	Control < 50 V	None	
	120 VAC, 8 AWG or smaller	100 mm	
	120 VAC, > 8 AWG	300 mm	
	600 VAC Power	300 mm	
	VFD or other high harmonic cable	300 mm	Metallic conduit
		600 mm	Other raceway
	Medium Voltage – 3C armoured and shielded	300 mm	May be in metallic conduit instead of armoured.
	Medium Voltage – 1C or 3C unshielded	450 mm	
Control < 50 V	120 VAC, 8 AWG or smaller	50 mm	
	120 VAC, > 8 AWG	300 mm	
	600 VAC Power	300 mm	
	VFD or other high harmonic cable	300 mm	Metallic conduit
		450 mm	Other raceway

Cable	Other Cable	Minimum Segregation	Notes
	Medium Voltage – 3C armoured and shielded	300 mm	May be in metallic conduit instead of armoured.
	Medium Voltage – 1C or 3C unshielded	450 mm	
120 VAC Control	120 VAC, 8 AWG or smaller	none	
	120 VAC, > 8 AWG	Metal barrier or 150 mm	
	600 VAC Power	Metal barrier or 150 mm	
	VFD or other high harmonic cable	150 mm	Metallic conduit
		300 mm	Other raceway
	Medium Voltage – 3C armoured and shielded	300 mm	May be in metallic conduit instead of armoured.
	Medium Voltage – 1C or 3C unshielded	450 mm	
120 VAC Power	600 VAC Power	Metal barrier	
	VFD or other high harmonic cable	150 mm	Metallic conduit
		300 mm	Other raceway
	Medium Voltage – 3C armoured and shielded	300 mm	May be in metallic conduit instead of armoured.
	Medium Voltage – 1C or 3C unshielded	450 mm	
600 VAC Power	VFD or other high harmonic cable	100 mm	Metallic conduit
		150 mm	Other raceway
	Medium Voltage – 3C armoured and shielded	150 mm	May be in metallic conduit instead of armoured.
	Medium Voltage – 1C or 3C unshielded	300 mm	

.1 For cables with voltages above 600 V, run cabling on separate cable trays, grouped according to the voltage level.

.2 Covers for cable trays for all exterior run cable trays. For cable trays interior to buildings, provide covers where shown on the Drawings.

3.3 Cables in Cable tray

.1 Install cables individually.

.2 Lay cables into cable tray. Use rollers when necessary to pull cables.

.3 For horizontal cabling secure cables in tray at intervals not more than 1.5 m in accordance with Rule 12-2202 6).

.4 For vertical cabling provide support clamps for cables in tray at intervals not exceeding those specified in Table 21. For distances less then those found in Table 21, at minimum a support clamp shall be provided at the top of the waterfall and again at the bottom of the waterfall. Between the provided support clamps, approved ties shall be provided in intervals not exceeding 1.2 m.

.1 Tie wraps are not permitted to support cables in vertical sections of cable tray, support must be provided in accordance with CEC Rule 12-120. Tie wraps may be used in horizontal sections of cable tray to maintain cable spacing.

3.4 Cables In Cable Channel

.1 Install cables individually.

.2 Lay cables into cable channel.

.3 For horizontal cabling secure cables in channel at intervals not more than 1.5 m.

3.5 Floor/Wall Seal Systems

.1 Coordinate openings with other disciplines for the required penetration width and depth of cable tray to pass through as required.

.2 All penetrations shall be sealed tight.

.3 Provide system to allow for cable re-entry to allow for future work.

.4 Indoor penetrations shall be trimmed flush, outdoor penetrations shall be provided with a metal cover over the entire outdoor exposed tray system.

.5 For all fire rated walls/floors/ceilings, provide fire stopping that complies with a tested cUL system arrangement to suit the fire rating required for the penetrations. Opening size/type and size of penetrating items shall be within the range specified within the cUL system detail. Fire blocks and stopping systems shall be protected from Ultraviolet (UV) radiation and water by at least a 7mm thick coating of firestop elastomeric sealant.

.6 For non fire-rated walls, the sealant shall equal the wall thickness. The material shall be heat and UV stable.

3.6 Identification

.1 Identify cables with nameplates in accordance with Division 26.

.2 Mark power and communication cables in accordance with colour coding outlined in Division 26.

.3 Provide yellow placards with black lettering on each tray section indicating the existing and maximum weight capacities:

CAUTION – BUILDING LIMITATION
*EXISTING CABLE WEIGHT LOADING IN THIS TRAY: _____ kg/m
**MAXIMUM CABLE WEIGHT LOADING IN THIS TRAY: _____ kg/m

*Where the cable tray system also supports other electrical installations, include these weights plus the weights of the cabling.

**Where the building manufacturer or structural engineer does not provide a weight limit for the tray system, the maximum design load for the class of tray shall be used.

END OF SECTION

INSTALLATION OF CABLES IN TRENCHES AND IN DUCTS

1. GENERAL

1.1 Description

.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section. This section supplements requirements of other Divisions.

.1 Section includes various materials for underground works that may be required for the project and the applications where each type shall be used.

1.2 References

.1 Canadian Standards Association (CSA):

.1 CSA C22.1: Canadian Electrical Code Part I (CEC) as amended by provincial, territorial or municipal authority having jurisdiction. References to CEC/MEC elsewhere in this document shall include reference to such amendments.

.2 CSA C22.3 No.7, Underground Systems.

.3 CSA Z809, Sustainable Forest Management, and Update No. 1.

.2 Forest Stewardship Council (FSC):

.1 FSC-STD-01-001 V5-2, FSC Principle and Criteria for Forest Stewardship.

.3 Sustainable Forestry Initiative (SFI):

1. SFI Standards and Rules.

.4 Winnipeg Electrical By-law (WEB):

.1 Winnipeg amendments to the Canadian Electrical Code (CEC).

.5 Winnipeg Building By-law (WBB):

.1 Winnipeg amendments to the National Building Code of Canada (NBC).

1.3 Submittals

.1 Submit in accordance with Division 1 and Division 26.

.2 Submittals shall include, but not be limited to the following:

.1 Submit manufacturer's instructions, printed product literature and data sheets for cables and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Precast manholes and handholes.

.3 Dimension drawings and descriptive literature.

.4 Cable pulling calculations for all cables.

.5 Proposed cable pulling methodology to ensure pulling forces are within the cable Manufacturer's limits.

2. PRODUCTS

2.1 Cable Protection

.1 Wooden Protection: 38 x 140 mm planks pressure treated with copper naphthenate or 5% pentachlorophenol solution, water repellent preservative. Must be rated Permanent Wood Foundation (PWF), All Weather Wood (AWW) is not acceptable. Creosote and some other types of wood preservatives may injure the insulation of conductors and should not be used.

.2 Concrete Topping Protection: Concrete topping of conduit in trench, minimum 50 mm thick layer of concrete, dyed red, with a 150 mm overhang, past the edges of each conduit installed for the length of the trench.

.3 For underground conduits or cables, provide mechanical protection as follows:

.1 120 V or 600 V and 15 A to 90 A: mechanical protection using treated planks 600 V and below; and 100 A or greater: mechanical protection using 50 mm thick concrete topping, or concrete duct banks as directed on the Drawings.

.2 600 V to 15 kV: mechanical protection using 50 mm thick concrete toping, or concrete duct banks as directed on the Drawings.

2.2 Markers

.1 Concrete type cable markers: 600 x 600 x 100 mm with words: cable, joint or conduit impressed in top surface, with arrows to indicate change in direction of cable and duct runs.

.2 Cedar post type markers: 89 x 89 mm, 1.5 m long, treated with copper naphthenate or 5% pentachlorophenol preservative, with nameplate fastened near post top, on side facing cable or conduit to indicate depth and direction of duct and cable runs.

.1 Nameplate: aluminum, anodized 89 x 125 mm, 1.5 mm thick mounted on cedar post with mylar label 0.125 mm thick with words Cable, Joint or Conduit with arrows to indicate change in direction. Fasten using stainless steel screws.

.3 Warning tape:

.1 Material: Polyethylene, 4-mil gauge with detectable strip.

.2 Color: Red.

.3 Width: Minimum 150 mm.

.4 Designation: Warning on tape that electric circuit is located below tape.

.5 Identifying Letters: Minimum 25 mm high permanent black lettering imprinted continuously over entire length.

.6 Manufacturers and Products:

.1 Panduit; Type HTDU.

.2 Reef Industries; Terra Tape.

.3 W.H. Brady Inc.

.4 Wieland Electric Inc.

3. EXECUTION

3.1 General

.1 Prior to excavation or directional boring, perform a complete site survey to ensure that the installation will not conflict with existing systems. Repair of damages to existing systems will be at the cost of the Contractor.

.2 Provide Universal GPS coordinates of all underground cable or conduit runs at every bend, and at a maximum of 6000 mm intervals. Include coordinates on the As-Built Drawings.

.3 Coordinate work with other trades to ensure that the location and route of the buried systems does not conflict with the work of other trades.

.4 Refer to the Drawings for cable / trench details where applicable. Where conflict in details occurs, allow for the more onerous and costly installation method.

.5 Perform all utility and underground locates, include “Call before you dig” (now Click-before-you-dig) to ensure all utilities are located/flagged: http://clickbeforeyoudigmb.com/

.6 Clearances to be in strict accordance with the Winnipeg Electrical Bylaws (WEB), CEC, and all other applicable by-laws.

3.2 Directional Drilling/Boring

.1 Perform directional boring as directed on the Drawings, or as specifically approved by the Contract Administrator. Otherwise, use open trenching installation methods.

.2 Directional boring shall utilize HDPE conduit.

3.3 Direct Burial of Cables

.1 Employ soft dig excavation methods near and around any buried electrical system. An acceptable soft dig method is Hydrovac (water based) excavation method.

.2 All cable / conduit trenches shall have a red plastic warning tape placed above, buried at a depth halfway between grade and the installation. The plastic tape is to completely cover all conduits and overlap the width of all conduits by at least 150 mm on either side. Use multiple parallel tape runs as required.

.3 Perform excavation and trenching. Provide sand bed in trench, and lay in cables, maintaining separation between cable runs. Maintain a minimum of 75 mm of clearance from each side of trench to the nearest cable. Do not pull cable into trench.

.4 Provide offsets for thermal action and minor earth movements. Offset cables 150 mm for each 60 m run, maintaining minimum cable separation and bending radius requirements.

.5 Minimum permitted radius at cable bends for rubber or plastic cables, 8 times diameter of cable; for metallic armoured cables, 12 times diameter of cables or greater in accordance with the Manufacturer's instructions. For communications cables minimum permitted radius is 15 the diameter of the cable or greater in accordance with the Manufacturer's instructions.

.6 Underground cable splices are not acceptable.

.1 Make terminations and splices (splices - only where specifically approved by the Contract Administrator) leaving 0.6 m of surplus cable in each direction. Terminations and splices shall be performed with approved kits, and in accordance with the Manufacturer's instructions and with specific training.

.7 Maintain a minimum of 150 mm horizontal separation between power cabling, increase to 190 mm separation if cabling is 1/0 or larger. For cables of different circuits add an additional 75 mm minimum separation.

.1 Maintain a minimum of 300 mm horizontal separation between power cabling and communication cabling.

.2 Maintain 300 mm (190 mm only where specifically approved by the Contract Administrator) minimum separation between power cabling from different sources/transformers.

.3 Maintain 300 mm minimum horizontal separation between low voltage (<100 0V) and medium voltage cables (>1000 V).

.4 Where possible, communication cables should have a minimum horizontal separation of 1000 mm from water and sewer lines and other deep services.

.8 Cable Crossing:

.1 Cable crossing shall be made at right angles (or as close to right angles as possible), with mechanical protection.

.2 Minimum burial depths shall be maintained per CSA C22.1 (Table 3) and CSA C22.3 No. 7 (Table 1). Increase the depth of cabling systems in a crossing to maintain minimum vertical separation, and minimum burial depth. Provide mechanical protection(s) as required.

.3 Provide sand bed over cables, after the cables are laid into the trench. Minimum sand bedding below cables is 75 mm. Minimum sand bedding above cables is 75 mm. Supply and install mechanical protection of cables above sand bedding. Use clean fill, devoid of rocks or materials which can damage or deform the cable trench.

.4 When low voltage cables (<1000 V) cross medium/high voltage cables (>1000 V) maintain 300 mm vertical separation with low voltage cables in upper position.

.1 When mechanical protection is provided, maintain a minimum 75 mm vertical separation between low voltage cables and 150 mm between medium/high voltage cables.

.5 Maintain 300 mm minimum lateral and vertical separation for fire alarm and control, cables when crossing other cables, with fire alarm and control cables in upper position.

.6 The Contractor must meet the minimum code clearance requirements when crossing of any other systems, such as mechanical or utility services.

.9 Mechanical Protection:

.1 Install pressure treated wood (PTW) planks on lower cables 600 mm horizontally in each direction at crossings.

.2 When intersecting other utilities and watermain (WM) works, provide horizontal mechanical protection between the services (i.e. if the WM is deeper, provide horizontal mechanical protection below the electrical service (i.e. sand layer). If the intersecting utility is above the electrical installation then the additional mechanical protection shall be provided above the electrical installation.

.3 Provide horizontal mechanical protection above conduits/cables for any location less than 1 m in burial depth. When horizontal protection is used above cabling systems it shall be provided at a minimum depth of 300 mm below finished grade. The minimum depth for the electrical installation when mechanical projection is provided above shall be buried 0.7 m below finished grade. Provide PTW a minimum of 100 mm thick.

.4 Provide vertical mechanical protection between trenches for any location where the horizontal distance between trench or other utility/services is less than 1 m (300 mm min with protection), or horizontal distance between a trench and light/utility pole or tree is less than 2 m (1.5 m min with protection), or horizonal distance between the trench and under ground structure (building or equipment foundation) is less than 1.2 m (300 mm min with protection). The minimum vertical height shall equal or exceed the sand layer when adjacent to utility/services, however, when adjacent to a light/utility pole it shall extend the height of the trench.

.1 Clarification: Reduction of horizontal separation between the trench and utility/services shall be coordinated with the utility/service prior to reducing separation distance. In some cases reduction may be approved by the utility/service, in other cases the full separation distance must be adhered to.

.10 Backfill:

.1 Use clean backfill, free of rocks and debris. Return excavation area to the original condition.

.2 Photograph all open trenches, with cabling, conduit, supports and spacers installed.

.3 Do not cover cabling or backfill until inspected by the Authority Having Jurisdiction (AHJ), and Contract Administrator. Do not close up trench without approval.

3.4 Cable Installation in Ducts

.1 Do not pull spliced cables inside ducts.

.2 Inspect and clean ducts prior to installing cables.

.3 Group raceways installed in same area.

.4 Utilize conductors that are rated for underground direct earth burial in underground ducts.

.5 Before pulling cable into ducts and until cables properly terminated, seal ends of cables with moisture seal tape.

.6 Install multiple cables in duct simultaneously.

.7 Use CSA-approved lubricants of type compatible with cable jacket to reduce pulling tension.

.8 Install cables as indicated in ducts.

.9 Provide expansion fittings that allow minimum of 100 mm of movement in vertical conduit runs from underground where exposed conduit will be fastened to or will enter building or structure. Provide slack loops in cable, compatible expansion fittings.

.10 To facilitate matching of colour coded multi-conductor control cables reel off in same direction during installation.

.11 After installation of cables, seal duct ends with duct sealing compound.

.12 Avoid moisture traps where possible. When unavoidable in exposed conduit runs, provide junction box and drain fitting at conduit low point.

.13 Install watertight fittings in outdoor, underground, or wet locations.

3.5 Markers

.1 Mark cable every 30 m along cable or duct runs and changes in direction or as indicated on the Drawings.

.2 Where markers are removed to permit installation of additional cables, reinstall existing markers.

3.6 Field Quality Control

.1 Perform tests in accordance with Division 26.

.2 Check phase rotation and identify each phase conductor of each feeder.

.3 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.

.4 If Voltage Drop (VD) measurements are taken for any reason during construction for any cabling that is part of an underground system, the value shall only be deemed valid in summer at a minimum ground temperature of 25˚C.

.5 Pre-acceptance test.

.1 After installing power cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.

.2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.

.3 Provide Contract Administrator with list of test results showing location at which each test was made, circuit tested and result of each test.

.4 Remove and replace entire length of cable if cable fails to meet any of test criteria.

3.7 Clean-up

.1 Repair damage to adjacent materials caused by cables installation.

.2 Repair surface to previous existing condition, or to new conditions specified on the Drawings, and in the Specifications.

END OF SECTION

FRACTIONAL HORSEPOWER MOTORS

1. GENERAL

1.1 Description

.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section. This section supplements requirements of other Divisions.

.1 Section includes various equipment and testing requirements that may be required for the project and the applications where each type shall be used.

1.2 References

.1 Canadian Standards Association (CSA):

.1 CSA C22.1: Canadian Electrical Code Part I (CEC) as amended by provincial, territorial or municipal authority having jurisdiction. References to CEC/MEC elsewhere in this document shall include reference to such amendments.

.2 CSA C22.2 No. 0, General requirements – Canadian Electrical Code, Part II.

.3 CSA C22.2 No. 77, Motors with inherent overheating protection.

.4 CSA C22.2 No. 100, Motors and Generators.

.5 CSA C22.2 No. 108, Liquid pumps.

.6 CSA C22.2 No. 145, Motors and Generators for Use in Hazardous Locations (Tri-national standard with NMX-J-652-ANCE and UL-674).

.7 CSA C390, Test methods, marking requirements, and energy efficiency levels for three-phase inductions motors.

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC), now known as Electro-Federation Canada:

.1 EEMAC M1-6, Motors and Generators.

.2 EEMAC M1-7, Motors and Generators.

.3 Factory Mutual Laboratories (FM Approvals LLC):

.1 3600, Electrical Equipment for Use in Hazardous (Classified) Locations – General Requirements.

.2 3615, Explosionproof Electrical Equipment – General Requirements.

.3 3616, Dust-Ignitionproof Electrical Equipment – General Requirements.

.4 National Electrical Manufacturers Association (NEMA):

.1 NEMA MG1, Motors and Generators.

.2 NEMA MG2, Construction and Guide for Selection, Installation and Use of Electric Motors and Generators.

.5 Underwriters Laboratories Canada (cUL):

.1 778, Motor-Operated water pumps.

1.3 Submittals

.1 In accordance with Division 1 and Division 26.

.2 Shop Drawings:

.1 Indicate dimensions, recommended installation procedure, wiring diagrams, sizes and location of mounting bolt holes and recommended support method.

.3 Quality Assurance Submittals:

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

.2 Manufacturer's Instructions: submit manufacturer's installation instructions.

.4 Closeout Submittals:

.1 Provide operational and maintenance (O&M) data for fractional horsepower motors for incorporation into manual.

2. PRODUCTS

2.1 Fractional Horsepower Motor

.1 HVAC and Equipment:

.1 Motors for belted fans and blowers shall have a minimum Class A or B insulation.

.2 Non-hazardous locations for Totally-enclosed and Totally-enclosed Pipe ventilated machines: to CSA C22.2 No. 100, EEMAC M1-6, and EEMAC M1-7.

.3 Hazardous locations for Explosion-proof and Dust-ignition-proof: to CSA C22.2 No. 145.

.2 Pumping and Submersible Applications:

.1 Pumps shall have a minimum Class F insulation.

.2 Non-hazardous locations: to CSA C22.2 No. 108, and UL-778.

.3 Hazardous locations: to CSA C22.2 No. 145, FM-3600, FM-3615, FM-3616.

.3 The mechanical integrity of the rotating system shall ensure torsional and lateral vibration are minimum to avoid troubles due to vibrations.

.4 Motor Size: 1/20 HP and up (1/8 HP, 1/6 HP, ¼ HP, 1/3 HP, ½ HP, ¾ HP, 1 HP):

.1 Voltage: 120V, or 208V (230V, 240V), 1-phase, 60 Hz.

.2 Service Factor: 1.0.

.3 Speed: 1-speed, or 2-speed.

.4 RPM: To suit application.

.5 Starting Method: Split phase, Permanent-split Capacitor, Capacitor Start.

.5 Motor Size: 1/8 HP and up (1/8 HP, 1/6 HP, ¼ HP, 1/3 HP, ½ HP, ¾ HP, 1 HP):

.1 Voltage: 208V or 575V, 3-phase, 60 Hz.

.2 Service Factor: 1.15 (Design A, B, or C motors).

.3 Speed: Squirrel cage, constant speed; minimum cooldown two (2) starts in succession followed by 15 minutes coast to rest prior to restart or better.

.4 RPM: To suit application.

.6 Motor with inherent overheating protectors.

3. EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Install wiring, flexible connections and grounding.

.2 Check rotation before coupling to driven equipment.

END OF SECTION

1. GENERAL

1.1 Description

.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section. This section supplements requirements of other Divisions.

.1 Section includes various equipment and testing requirements that may be required for the project and the applications where each type shall be used, this section also partially overlaps the Fractional Horsepower Motors specification.

.2 Low voltage electric motors and accessories, furnished under other Sections, and which are a part of equipment assemblies (including pumps) shall be in conformance with the requirements specified in this Section, unless otherwise noted. This section includes performance, and descriptive type specifications.

.1 All items of electrical equipment that are furnished with process, heating, ventilating, or other equipment shall conform to the requirements specified under the applicable electrical sections of the Division 26 Specifications. Enclosures for electrical equipment such as switches, starters, etc., shall also conform to the requirements specified under the applicable electrical sections of the Division 26 Specifications.

.3 Unless otherwise specified or approved, all electric motors furnished and installed by the Contractor shall conform to the requirements specified herein.

.1 Motors connected to variable frequency drives shall be inverter-duty rated in accordance with the requirements of NEMA MG 1.

.2 Three phase motors rated 0.75 kW and larger shall be of the premium efficiency, “Design E”, type per Table 12.1 of NEMA MG1 Part 12. Motors shall have a NEMA Nominal Efficiency not less than the values referenced in NEMA MG1. Efficiency values shall be based on tests performed in accordance with IEEE Publication No. 112, Method B. Motors with horsepower or motor speeds not listed shall conform to comparable standards of construction and materials as those for listed motors.

1.2 References

.1 American Bearing Manufacturers Association (ABMA).

.2 American National Standards Institute (ANSI), Hydraulic Institute (HI):

.1 ANSI/HI 9.6.3, The Rotodynamic (Centrifugal and Vertical) Pumps – Guideline for Allowable Operating Region .

.3 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):

.1 90.1, Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings.

.4 Canadian Standards Association (CSA):

.1 CSA C22.1: Canadian Electrical Code Part I (CEC) as amended by provincial, territorial or municipal authority having jurisdiction. References to CEC/MEC elsewhere in this document shall include reference to such amendments.

.2 CSA C22.2 No. 100, Motors and Generators.

.3 CSA C22.2 No. 145, Electric motors and generators for use in hazardous (classified) locations (Tri-national standard with NMX-J-652-ANCE and UL-674).

.5 National Electric Manufacturers Association (NEMA):

.1 MG 1, Motors and Generators.

.6 Institute of Electrical and Electronics Engineers (IEEE).

.1 112, Standard Test Procedure for Polyphase Induction Motors and Generators.

.2 114, Standard Test Procedure for Single-Phase Induction Motors.

.3 1349, Guide for the Application of Electric Motors in Zone 2 and Class 1, Division 2 Hazardous (Classified) Locations.

1.3 Submittals

.1 Submittals in accordance with Division 1 and Division 26.

.2 Shop drawings and descriptive data to include:

.1 Descriptive literature and motor characteristics.

.2 Complete list of all motors and their associated Tags to be furnished.

.3 Outlines, dimensions, weights, and wiring diagrams.

.1 Overall dimensions of motor.

.2 Shaft centreline to base dimension.

.3 Shaft extension diameter and keyway, coupling dimensions and details.

.4 Fixing support dimensions.

.5 Dimensioned position of ventilation openings. Details of ventilation duct attachments.

.6 Arrangement and dimensions of accessories.

.7 Location of main and accessories boxes with size of conduit entrance.

.8 Location of horizontal and vertical drains.

.4 Mounting Plate type and size.

.5 Terminal box location and size of terminals.

.6 Starting current and relative data necessary for use in design of motor starting equipment.

.7 Speed/torque characteristic.

.8 Routine tests shall be performed on representative motors and shall include the information described on NEMA MG 1-12.61. Efficiency shall be determined in accordance with IEEE Publication No. 112, Method B. Power factor shall be measured on representative motors. Include efficiency and power factor at 1/4, 1/2, 3/4 and full load.

.9 Motor nameplates shall be stainless steel. Include data for NEMA Standard MG1, as applicable. Permanently fasten nameplate to motor and position for easy inspection.

.10 Strip heaters kW and voltage ratings.

.11 Power factor correction capacitors, where required.

.12 Built in overload protection device.

.13 Starting restrictions, acceleration time-current curve of motor starting load (100 hp and larger).

.14 Thermal damage curve and allowable stall time, full voltage (100 hp and larger).

.15 Installation and maintenance data.

.1 Bearing design data, grease requirements and part numbers.

.16 Shop test reports.

.17 Submit Pump, Motor and VFD, if applicable for a complete review; Coordination Certificates.

.3 Closeout Submittals:

.1 Provide maintenance data for incorporation into O&M.

.2 Data necessary for maintenance of motors.

.3 Field acceptance test reports.

.4 Manufacturer's recommended list of spare parts.

2. PRODUCTS

2.1 Materials

.1 Motors:

.1 Non-hazardous locations: to CSA C22.2 No. 100.

.2 Hazardous locations: to CSA C22.2 No. 145.

2.2 Finish Painting and Corrosion Prevention

.1 Provide equipment resistant to corrosion from severe moisture conditions.

.2 Unless otherwise specified, motors shall be given a shop application of paint filler or enamel sealer, a flat coat of undercoater for enamel, and two coats of enamel or, in lieu of this treatment, other corrosion-resistant treatment customary with the manufacturer.

2.3 Electric Motor Ratings

.1 As indicated on drawings or in the specifications.

.2 Motors shall comply with NEMA MG1, unless otherwise specified.

.3 HVAC Applications: Meets the energy efficiency requirements of ASHRAE 90.1 Table 10.

.4 All polyphase non-explosion proof motors shall be designed for energy efficient operation and meet the requirements of MG 1-12.53 a and b.

.5 Voltage ratings:

.1 Unless otherwise specified, motors with ratings of 0.37 to 261 kW (0.5 to 350 hp) shall be rated 600 V (nameplate rating), three-phase, 60 hertz; motors 0.25 kW or less to be rated 115 V, single-phase, 60 hertz.

.2 High-voltage motors, if indicated on drawings, shall be specified elsewhere in the specifications.

.6 The following specific motor requirements shall be in the equipment specifications:

.1 Motor speed.

.2 Motor enclosure type.

2.4 Design Letters and Application

.1 Every motor shall be of sufficient capacity to operate the driven equipment under all load and operating conditions without exceeding its rated nameplate current or power or its specified temperature limit at rated voltage. Each motor shall develop ample torque for its required service throughout its acceleration range at a voltage 10% below nameplate rating. Where indicated on the electrical drawings to be operated on a reduced voltage starter, the motor shall develop ample torque under the conditions imposed by the reduced voltage starting method.

.2 The motor shall have sufficient capacity to operate the driven equipment as given in the equipment detail specifications. The motor shall not be required to deliver more than its rated nameplate horsepower, at unity (1.0) service factor, under any condition of mechanical or hydraulic loading.

.3 Motor suitable for driving centrifugal pumps, fan blower, compressor, or gears as indicated or required for the application.

.4 All motors shall having starting characteristics and ruggedness as may be necessary under the actual conditions of operation and, unless otherwise specified, shall be suitable for full-voltage starting.

.1 In addition, motors shall be rated inverter duty for any variable frequency drive (VFD) or soft starter applications.

.2 Inverter duty rated: Motors for operation on variable frequency drives shall meet performance standards in NEMA MG 1, Part 31. Enclosures shall be equal to those furnished for severe duty or explosion proof motors. Motor shaft and bearings shall be insulated. Internal service factor shall be 1.15 that of the nameplate. Ventilation system shall be designed for maximum heat transfer. Stator laminations shall be stagger-stacked and stamped from high grade electrical steel to minimize eddy-current losses and heat build-up caused by inverter induced harmonics. Rotors shall be configured to minimize skin-effect heating.

.5 Submersible motors shall be manufacturer's standard.

.6 Hermetically sealed air conditioning units, elevators, hoists, cranes and other devices complying with special safety codes shall be furnished with motors, control equipment, accessories and safety devices for approved, safe, and efficient operation, in accordance with the manufacturer's standards and to be rated for the duty cycle as specified for the driven equipment. Minimum service factor 1.15 above 2.25 kW.

.7 Chemical duty motors shall be provided with severe duty rating.

.8 For 3-phase motors:

.1 Three-phase motors shall not be provided with starting capacitors.

.2 All three-phase motors shall be provided with a 1.15 service factor.

.3 All three-phase two-speed motors shall be of the two-winding design.

.4 Design B for typical applications such as machine tools, fans, blowers, centrifugal pumps, and misc. pumps.

.5 Design C for typical applications such as machine compressors, string machines, agitators, reciprocating pumps, crushers, and conveyors.

.6 Design D for typical applications such as punch presses, flywheels (such as punch presses, shears, elevators, extractors, winches, hoists), oil-well pumping, and wiredrawing machines.

.9 For 1-phase motors:

.1 Design L type (<= 1HP), and Design M type (>= 1.5 HP) and/or suitable for the application:

.1 Single-phase motors requiring switching devices and auxiliary starting resistors, capacitors, or reactors shall be furnished as combination units with such auxiliaries either incorporated within the motor housings or housed in suitable enclosures mounted upon the motor frames. Each combination unit shall be mounted upon a single base and to be provided with a single conduit box.

.2 Permanent Split Capacitor (PSC) type for typical applications such as direct-drive fans, and blowers.

.3 Split-Phase type for typical applications such as belt-drive and direct-drive fans and blowers, small tools, centrifugal pumps, and appliances.

.4 Capacitor-Start type for typical applications such as pumps, compressors, tools, conveyors, farm equipment, and industrial ventilators.

2.5 Enclosure Types

.1 Motors shall have a steel or cast-iron frame and a cast iron or stamped steel conduit box, as specified below. Conduit box shall be split from top to bottom and shall be capable of being rotated to four positions. Synthetic rubber-like gaskets shall be provided between the frame and the conduit box and between the conduit box and its cover. Motor leads shall be sealed with a non-wicking, non-hygroscopic insulating material. A frame mounted pad with drilled and tapped hole, not less than 6 mm diameter, shall be provided inside the conduit box for motor frame grounding.

.2 Chemical duty motors shall be of the corrosion resistant type conforming to motors designated by the manufacturer as Corro-Duty, Mill and Chemical, Custom Severe Duty, or similar quality designation. Severe duty motors shall have a cast iron frame, cast iron end brackets, cast iron conduit box and 1.15 service factor at 40°C and tapped drain holes (corrosion resistant plug for frames 286T and smaller and automatic breather/drain devices for frames 324T and larger).

.3 Vertical motors of the open type shall be provided with drip hoods of acceptable shape and construction. When the drip hood is too heavy to be easily removed, provision to be made for access for testing.

.4 Totally enclosed motors shall be provided with automatic breather and drain.

.5 Includes lifting eyes or lugs.

.6 Ordinary Location (i.e. clean, and dry locations):

.1 Open drip proof fully guarded (ODP).

.7 Category 1 Wet Area, Non-Hazardous Area (i.e. where dirt or dampness exists):

.1 Totally enclosed non-ventilated (TENV):

.1 Lighter load equipment.

.2 TENV motors shall include the same rating and accessories as specified for TEFC motors.

.2 Totally enclosed fan cooled (TEFC):

.1 Heavier load equipment. Used on pumps, compressors, fans, and other belt-driven and direct connected equipment.

.2 TEFC motors shall have a steel or cast-iron frame, cast iron end brackets, cast iron conduit box, 1.15 service factor at 40°C, tapped drain holes (corrosion resistant plugs for frames 286T and smaller and automatic breather/drain devices for frames 324T and larger) and upgraded insulation by additional dips and bakes to increase moisture resistance.

.8 Hazardous Area (Category 1, Category 2 Area):

.1 Explosion proof motors shall comply with all requirements for the hazardous locations as defined by the CEC and with all other safety codes pertaining thereto.

.2 Totally enclosed explosion proof for use in the following hazardous locations:

.1 Gases: Class I Division 1,2 Group A, B, C, D. (Class 1 Zone 0, 1, 2).

.2 Dusts: Class II Division 1, 2 Group E, F, G. (Class 1 Zone 20, 21, 22).

.3 Fibers: Class III Division 1, 2 (Class 1 Zone 20, 21, 22).

.4 Enclosure to house Temperature switch for monitoring enclosure surface temperature.

.5 The Temperature switch shall be set such that a temperature exceeding 80% of the auto-ignition temperature of the specific gas, vapor, or fiber in the area where the equipment is intended to be used shall shut down the motor.

2.6 Performance Characteristics

.1 As required on the drawings or specifications.

.2 The Contractor shall furnish the Contract Administrator with five certified copies of characteristic curves of each motor furnished, except 115 V motors. Curves shall be supplied as a part of the driven equipment submittal.

2.7 Insulation

.1 All motors shall have Class B or Class F insulation with temperature rise by resistance at full load rating of a Class B insulation in accordance with NEMA MG 1, and based on a maximum ambient temperature of 40°C unless otherwise specified.

.2 Insulation systems shall be manufacturer’s premium grade, resistant to attack by moisture, acids, alkalis and mechanical or thermal shock for 600 V motors. Provide 80°C, Class B rise or better by resistance at 100% load and provide a Class F insulation system, suitable for an ambient temperature motor operation of 0 to 40°C at no more than 1000 m above sea level for inverter duty motors. This temperature rise shall be met when motors are operated and controlled with the VFD(s). The motor insulation system shall have full capability to handle the common mode voltage conditions imposed by the VFD.

.3 Motor windings shall be braced to withstand successfully the stresses resulting from the method of starting. The windings shall be treated thoroughly with acceptable insulating compound suitable for protection against moisture and slightly acid or alkaline conditions.

.4 Motors for outdoor service shall have vacuum/pressure impregnated epoxy insulation for moisture resistance.

.5 Insulation for inverter duty motor windings shall meet or exceed the Pulse Endurance Index for magnetic wire and shall not be injured when exposed to repeated pulse type waveforms, repetitive high voltage transients, switching frequency and rate of rise of the pulse. Class H varnish shall be used.

2.8 Bearings

.1 Antifriction type bearings, fitted with readily accessible facilities for lubrication while motor running or stationary.

.2 Vertical motors shall be provided with thrust bearings adequate for all thrusts to which they can be subjected in operation.

.3 Bearings shall be of the self-lubricating type, designed to ensure proper alignment of rotor and shaft and to prevent leakage of lubricant.

.1 Bearings for open motors shall be of the sleeve or ball type, as specified under the respective items of mechanical equipment.

.2 Bearings for totally enclosed and explosion proof motors shall be of the ball type.

.3 Bearing minimum L-10 fatigue life at 100% load shall be 50,000 hours.

.4 Bearing grease shall be of the 120°C thermal capability type.

.4 Hazardous areas/locations: Insulated bearings shall be utilized in hazardous applications where motors are run from VFDs or soft starters. Include bonding/grounding kits.

2.9 Shaft

.1 Standard shaft extension.

2.10 Thermal Protection

.1 Factory installed thermistors, one in each phase, wired to identify terminals in motor terminal box.

.2 For Submerged pump motors in the vertical position.

.1 Install Xylem/Flygt Leakage Sensor (FLS) in series with motor winding thermistors.

2.11 Motor terminal boxes and leads:

.1 Terminate winding connection necessary for appropriate starting method and identify in motor terminal box.

.2 Motors shall be furnished with oversize conduit terminal boxes to provide for making and housing the connections, and with flexible leads of sufficient length to extend for a distance of not less than 100 mm beyond the face of the box. The size of cable terminals, and terminal box conduit hoses shall be as permitted by the Contract Administrator. An acceptable type of solderless lug to be furnished. Totally enclosed and explosion proof motors to have cast-iron terminal boxes.

.3 Leads for space heaters shall be brought out into an auxiliary, cast, conduit box on the motor side opposite to the main terminal box. Auxiliary box to have 50 mm (1 inch) threaded conduit openings and shall be so constructed that conduit entrance may be placed at top, bottom, or either side.

.4 A grounding terminal shall be provided in the main terminal box and a bronze grounding bolt to be furnished at the conduit side of the motor frame.

2.12 Accessories

.1 Shaft extension: as necessary for accessories.

.2 Brake as identified on the drawings or in the specifications: electrically operated.

.3 Motor heaters shall be supplied on all motors installed outdoors or in unheated areas. Heaters shall be of the cartridge or flexible wrap around type installed within the motor enclosure adjacent to core iron. Heaters shall be rated for 120 V, single phase with wattage as required. The heater wattage and voltage shall be embossed on the motor nameplate.

.4 Accessories: suitable for use in same hazardous location as the specified for motor.

.5 Include anchor devices and setting templates.

2.13 Extra Materials

.1 Provide maintenance materials and spare parts in accordance with Division 1.

.2 Furnish one spare bearing of each type for each motor size and type.

2.14 Motor Shop Tests:

.1 Motor shop tests shall be made in accordance with the IEEE Test Codes as specified in the NEMA MG 1. NEMA report-of-test forms to be used in submitting test data.

.2 Motor efficiency shall be determined by use of IEEE Standard 112 Test Method B, and by use of MG 1-12.53 a and b.

.3 For induction motors larger than 75 kW, complete tests of each motor furnished to be made and certified tests data sheets to be submitted, unless witness shop tests are required by the technical specifications pertaining to the equipment. Each motor shall be tested at rated voltage for: efficiency and power factor at 25, 50, 75, and 100% of it rated horsepower; for temperature rise, torque, no-load current, starting current, full load current, and dielectric strength; and for compliance with all specified performance requirements.

.4 For induction motors 3.75 kW up to and including 75 kW, copies of routine tests reports of electrically duplicate motors shall be furnished.

.5 Test data not required for motors 2.25 kW or less.

2.15 Delivery, Storage, and Handling

.1 Shipping:

.1 Ship motors assembled to driven equipment complete except where partial disassembly is required by transportation regulations or for protection of components.

.2 Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.

.3 Deliver spare parts at same time as associated devices. Deliver to City after completion of Work.

.2 Receiving and Storage:

.1 Inspect and inventory items upon delivery to Site.

.2 Store and safeguard equipment and material in heated storage facility as recommended by equipment manufacturer and required by Section 01 65 00.

.3 Protect motors from moisture at all times.

.3 Prolonged Storage:

.1 For extended outdoor storage, remove motors from equipment and store separately.

.2 If storage is anticipated to be longer than two months, store in accordance with the manufacturer instructions including the following additional steps.

.3 Keep motor space heaters energized.

.4 Fill the oil reservoirs of motors with sleeve bearings to the proper level with the specified oil.

.5 Motors with anti-friction bearings to receive an initial change of grease and then be re-greased every six (6) months.

.6 Remove the motor shaft braces and the rotate motor shaft every two (2) weeks. Replace the shaft braces prior to relocation to the installation site. Under no circumstances should the motor be lifted without the braces in place.

3. EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Dry out motor if dampness present in accordance with manufacturer's instructions.

.2 Install motor rigid plumb and square, using only lifting facilities provided.

.3 Make wiring connections.

.1 Use liquid tight PVC jacketed flexible conduit between rigid conduit and motor.

.2 Make flexible conduit long enough to permit movement of motor over entire length of slide rails.

.4 Check for correct direction of rotation, with motor uncoupled from driven equipment.

.5 Align and couple motor to driven machinery to manufacturer's instructions, using only correct parts such as couplings, belts, sheaves, as provided by manufacturer.

3.3 Field Quality Control

.1 Perform tests in accordance with Division 26.

.2 Tests performed on the Thermistor or FLS sensors shall not exceed 12 VDC.

.3 Ensure the motor operates as intended during testing of the individual equipment and during process commissioning. Perform testing in accordance with Division 26.

END OF SECTION

1. GENERAL

1.1 Description

.1 Provide electrical heat trace system as part of piping and insulation system furnished under other sections. Typical coordination involves Division 23, 33, 40 for new and existing (where applicable) piping systems to prevent freezing.

.1 Work shall be performed in cooperation with other trades on the project and so scheduled as to allow efficient completion of the project. Materials and equipment shall be installed as fast as conditions will permit, and installed properly.

.2 The Work of this Section shall include all labor, materials, tools, equipment and appurtenances, and performing all operations necessary to furnish and install complete systems in accordance with this Section of these Specifications, the Drawings, and the codes and standards listed herein.

.3 Attend regular coordination and job progress meetings required.

.1 Comply with all laws, ordinances, rules, codes, standards, regulations, bulletins, by-laws, and orders of all authorities having jurisdiction relating to this work, and enforced in the locality of jobsite. If otherwise specified herein the bare minimum of the code(s) and requirements shall first be met, and specified requirements shall be in addition to the code(s) and requirements.

.1 Supply and install all material, equipment, wiring, and labour necessary for the installation of the systems detailed on the Drawings in accordance with the latest edition of the Canadian Electrical Code, Manitoba Electrical Code, and building codes.

.2 The General Conditions, Supplementary Conditions, and Division 1 are a part of this Specification and shall apply to this Division.

.1 The intent of the Drawings and Specifications is to include all labour, products, and services necessary for complete Work, tested and ready for operation.

.2 These Specifications and the Drawings and Specifications of all other Divisions shall be considered as an integral part of the accompanying Drawings. Any item or subject omitted from either the Specifications or the Drawings, but which is mentioned or reasonably specified in and by the others, shall be considered as properly and sufficiently specified and shall be provided.

.3 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 Bid.

.4 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.

1.2 Summary

.1 The Scope of Work for this Section includes, but is not limited to, the following:

.1 Materials and procedures for the provision and installation of thermal insulation and heat tracing for process piping systems as indicated in the Drawings.

.2 Furnish and install a complete system of heaters, components, materials, and controls to prevent piping from freezing.

1.3 References

.1 Except as specified herein, the latest edition of the standards listed below form a part of this Specification to the extent referenced in this Section. Where earlier editions of standards are adopted as referenced in applicable codes, those shall govern. The publications are referred to within the text by the basic designation only.

.2 In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

.3 American Society for Testing and Materials (ASTM):

.1 A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

.2 A240, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

.3 B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.4 C441, Standard Test Method for Effectiveness of Pozzolans or Ground Blast-Furnace Slag in Preventing Excessive Expansion of Concrete Due to the Alkali-Silica Reaction.

.5 C1136, Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.

.6 E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

.4 Canadian Standards Association (CSA):

.1 C22.1, Canadian Electrical Code Part I (CEC) as amended by provincial, territorial or municipal authority having jurisdiction. References to CEC/MEC elsewhere in this document shall include reference to such amendments.

.2 C22.2 No. 130, Requirements for electrical resistance trace heating and heating device sets.

.5 Institute of Electrical and Electronics Engineers (IEEE):

.1 IEEE 844.2 (CSA C293.2), Standard for Skin Effect Trace Heating of Pipelines, Vessels, Equipment, and Structures – Application Guide for Design, Installation, Testing, Commissioning, and Maintenance

.6 National Electrical Manufacturers Association (NEMA):

.1 250, Enclosures for Electrical Equipment (1000 volts maximum).

.7 National Fire Protection Association (NFPA):

.1 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.

.8 Underwriters Laboratories Ltd (cUL):

.1 CAN/ULC S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

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

1.4 Definitions

.1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these Specifications, and on Drawings, are those defined by IEEE SP1122.

.2 All terminologies, abbreviations, and acronyms used in this Document are as listed in the various Standards, Codes, Rules, and Bulletins used herein.

.3 Where the word *install* is used, unless specifically specified, is also meant to include the supply of the equipment.

.4 The term “Shop Drawing” means drawings, diagrams, illustrations, schedules, performance characteristics, brochures and other data, which are to be provided by the Contractor to illustrate details of a portion of the Work. Indicate materials, methods of construction and attachment of support wiring, diagrams, connections, recommended installation details, explanatory notes and other information necessary for completion of Work. Where equipment is connected to other equipment, indicate that such items have been coordinated, regardless of the Section under which the adjacent items will be supplied and installed. Indicate cross references to Design Drawings and Specifications.

1.5 System Description

.1 Provide heat tracing system for other piping systems, as specified by other Divisions.

.2 Design Requirements:

.1 Provide pipe tracing cable system capable of maintaining pipe contents at a temperature deemed acceptable by the Division responsible for furnishing the piping and insulation system. At a minimum the pipe tracing cable system capable of maintaining pipe contents at temperature of 4˚C when outside ambient temperature is -40˚C with 32 km/hr wind.

.1 The “temperature deemed acceptable” shall be referred to hereinafter as the “specified temperature”

.2 Verify heating requirements with Division responsible for furnishing the piping and insulation system.

.3 The design, equipment, and installation shall meet all codes, regulations, and manufacturers requirements. Where manufacturer requirements for certification or

installation are above the minimum requirements of the code the more stringent shall apply.

.3 Environment:

.1 All heat trace boxes, connections, and control enclosures shall be rated for the environment in which they are installed. The installation method shall always assume moisture can be present which may affect the heat trace element and its connections, therefore no connection shall take place below grade where the potential to submerge the connection due to groundwater.

.2 Water-tight fittings/connections alone will not be considered suitable for submergence due to groundwater and will be rejected.

.3 Normal Locations (Indoor or Outdoor).

.1 Where heat trace is required in normal locations the system shall be designed for use in Category 1 locations.

.4 Hazardous Areas (Zone 0, Zone 1, Zone 2) (Indoor or Outdoor):

.1 Where heat trace is required in hazardous locations the system shall be designed for the Gas groups present and for use in Category 2 locations. Gas Groups at minimum shall include Group IIA & IIB gases unless additional requirements are called out on the Hazardous Classification diagram or drawing.

.2 Where equipment does not come with the maximum surface temperature rating the system shall be deemed at maximum of 100˚C in accordance with CEC 18-054.

1.6 Submittals

.1 Submit the following Shop Drawings in accordance with Division 1.

.2 The Contractor shall have Shop Drawing Submissions prepared for all aspects of the work relating to the design and construction of heat trace cables and/or controllers, including heat trace calculations to accommodate the proposed materials. The Shop Drawing Submission shall be in sufficient detail to permit review of materials for compliance with this Specification and facilitate assembly in the field complete with all necessary connection details.

.1 Complete manufacturers material/product data, "K" value temperature rating, density, finish, recovery jacket of materials proposed for this project and indicate thickness of material for individual services.

.2 Show isometric layout of pipe tracing cables over piping layout.

.3 Include installation details and connection diagrams sufficient to install pipe tracing cable system.

.3 Furnish to all other trades advance layout information and Shop Drawings necessary to permit other trades affected by the Work to install their work properly coordinated and without delay.

.4 Include heat trace calculations for the materials and application. Refer to the Schedules provided later in this section for minimum typical values should preliminary material selection not be available to assist with preliminary calculation review.

1.7 Shipment, Protection and Storage

.1 Deliver material to Site in original non-broken factory packaging, labeled with Manufacturer's density and thickness.

.2 Perform Work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Make good separation of joints or cracking of insulation due to thermal movement or poor workmanship.

1.8 Quality Assurance

.1 Comply with the requirements specified in Division 1.

.2 Install insulation employing skilled workers regularly engaged in this type of Work.

.3 Materials shall meet or exceed fire and smoke hazard ratings as stated in this Section and defined in applicable building codes.

.4 All items/equipment provided under this section shall come with appropriate certificates/markings for use in Manitoba, for the environment for which it’s installed, meet all applicable electrical codes, and conform with Division 26.

.5 All work shall be performed in accordance with the latest edition of the Canadian Electrical Code, with amendments from the Manitoba Electrical Code. Install all material, equipment, wiring, and labour necessary for the installation. The installation shall also be performed to all manufacturer installation requirements.

.6 With the acceptance of the Contract Administrator and without extra cost to the City, make reasonable modifications in Work specified under this Section of the Specifications required to coordinate with normal structural interference's, or for proper execution of specified work.

.7 If Work is installed before coordinating with other trades so as to cause interference with the work of such trades, make all necessary changes in Work under this Section of the Specifications at no additional cost to the City.

.8 Protect all materials and work of other trades from damage that may be caused by the Work required under this Section of the Specifications and be responsible for repairing any damages caused by such work without any additional cost to the City.

2. PRODUCTS

2.1 Acceptable Manufacturers

.1 Urecon Ltd.

.2 Raychem.

.3 Or approved equal.

2.2 Electric Heat Tracing

.1 Provide proper fittings and all appurtenances for a complete and working system. And for the field connections through conduit systems, and interconnection wiring without need for procurement of special fittings or wiring devices.

.2 Heat tracing conduits:

.1 From the controller box use rigid galvanized conduit for the heater element cables, and a separate RVPC conduit for the sensor cable. The conduit wall penetrations shall be sealed to prevent water and gas ingress to the facility.

.2 Consisting of extruded plastic moulding and applied to pipe prior to application of insulation.

.3 Fasten securely to pipe and seal to prevent ingress of foam during insulation.

.4 Check conduit after insulating to ensure they are not plugged.

.5 Seal ends prior to shipping to prevent foreign material from entering conduit while in transit or during installation.

.6 Conduit shall be provided between the control box and the point of heat trace. Provide suitable strain reliefs to transition the heat trace element and sensor to the piping.

.1 One conduit and strain relief will be the heat trace cable feed.

.2 One conduit and strain relief will be used for the heat trace return (where duplex heat tracing is used).

.3 One conduit and strain relief will be for the sensor.

.4 Strain reliefs shall be rated for the environment for which they’re installed.

.7 Manufacturer to ensure that specified electric tracing cable and heat tracing conduit size are compatible, so that cable may be pulled in with relative ease.

.8 For plastic pipe:

.1 Aluminum tape (AT180) shall be applied between the heater element and piping wall where channel is not provided, or in areas where channel does not bridge gaps. The heater element cable shall be supported with Fiberglass tape onto the piping in intervals recommended by the manufacturer.

.2 In applications where a channel is provided the channel shall be D-shaped and in direct contact with the piping, the heater element shall be inserted into the channel.

.9 To provide a good ground path where none exists and to enhance the heater’s ruggedness, the heater shall have a metallic grounding overbraid of sufficient conductivity to carry fault current made of tinned-copper and an outer jacket of modified polyolefin or secondary Fluoropolymer extruded overjacket.

.10 In order to provide energy conservation and to prevent overheating, the heater shall have a self-regulating factor of a least 90%. The self-regulation factor is defined as the percentage reduction, without thermostatic control, of the heater output going from 4ºC (40ºF) pipe temperature operation to 65ºC (150ºF) pipe temperature operation.

2.3 Cable Design

.1 Voltage: 120 volts, 1PH, 60 Hertz, as shown on Drawings for electrical connection.

.2 Parallel design, current flow across cable.

.3 Heat output: 15 watt/m constant (1 w/ft = 3.28 watt/m), independent of length.

.4 Self-regulating heat output, resistive parallel circuit type, constant watt rated.

.1 The cable shall be CSA Certified for use on plastic pipe and the manufacturer will be required to provide documentation of same.

.2 Provide duplex heat tracing or single heat tracing as noted on Drawings.

.3 The heat trace cable shall be continuous with the only terminations taken place within the junction box above grade (all splicing, sealing, and connections are to conform to the manufacturer's requirements; the heater elements shall only be terminated within the junction box). Termination boxes shall be rated for the environment for which they’re installed.

.4 The self-regulating heater element shall at a minimum consist of two (2) 16 AWG tinned-copper bus wires embedded in parallel in a self-regulating polymer core that varies its power output to respond to temperature all along its length, allowing the heater to be crossed over itself without overheating (hot spots), to be used with plastic pipe, and to be cut to length in the field. The heater shall be covered by a radiation cross-linked modified polyolefin dielectric jacket, and suitable for cutting to length in field.

2.4 Controllers (Control Box)

.1 Provide an adjustable setpoint controller with solid state switching circuitry suitable for use with RTD type temperature sensors. Controllers in the Contract are intended for control of the heat trace cable on the pre-insulated piping, at the locations noted on the Construction Drawings. Controllers shall conform to the following design features:

.1 Suitable for control of the cable specified for use on plastic pipe.

.2 Thermostatic ambient sensing control on each tape set to the desired temperature for the pipe contents, as specified by other Divisions. Where not specified, the Thermostatic ambient sensing control on each tape shall be set at 5˚C (41˚F).

.1 Provide non-adjustable thermostats, calibrated and tested at factory to operate pipe heating system when temperature of pipe drops to the specified temperature.

.2 Provide non-adjustable thermostats, calibrated and tested at factory to close alarm contacts when temperature of pipe drops to 2˚C at coldest location.

.3 RTD Sensors and monitoring circuitry to have repeatability and maximum temperature differential of 1°C (2°F).

.3 Ordinary Locations (unclassified):

.1 Set Hi-temperature cut out trip/alarm to: 29°C (84°F).

.2 Provide thermostats with a minimum CSA/NEMA 4X enclosures or as required to suit environment.

.3 Control Box: minimum CSA/NEMA 4X, weatherproof.

.4 Hazardous Locations:

.1 Set Hi-temperature cut out trip/alarm to: 20°C (68°F).

.2 All components shall be rated for the hazard. Installation means and methods shall follow CEC Section 18 & Section 22.

.5 Set Low-temperature alarm when the temperature of the pipe drops below: 2°C (35°F).

.6 Electric heat tracing voltages shall be selected as indicated on the Drawings.

.7 Minimum Circuit Breaker Typical Sizes (See drawings panelboard schedule). Should the Controller (Control Box) not inherently have built in GFCI protection provide GFCI type breakers at the panelboard:

.1 30A, 2 pole, single throw for 152 mm watermain.

.2 15A, 1 pole for 25 mm water service.

.3 15A, 1 pole for 32 mm sewer line.

.8 Controller to have option for manual bypass (48-hour) of controls and to include indicators lights to indicate Power on, Heater on, High Temp alarm trip. Controller shall also come with Ground Fault monitor/trip (GFCI protection).

.9 Controller to be installed and positioned for easy viewing and maintenance. Install location as indicated on the Drawings.

.2 Entry holes for wiring:

.1 2 x 1" top and bottom: power in, heater out.

.2 1 x 1/2" on the side for sensors.

.3 Electrical Fittings:

.1 Electrical fittings such as splice kits, end seals, etc. shall conform to the product supplied by the manufacturer of the heat trace cable and shall conform to the applicable CSA Standards for manufacture and installation.

.2 Provide proper fittings and appurtenances for field connection of system to conduit and wiring without need for procurement of special fittings or wiring devices.

.3 Terminal end seal kits: certified for installation in damp conditions and consisting of:

.1 Constant watt.

.2 End connector.

.3 900 mm of Teflon tape.

.4 Adhesive-lined heat shrink end cap.

.4 Power connection kits: connect to pipe.

.1 Constant watt.

.2 Flexible conduit.

.3 End caps.

.4 12 AWG hook-up wire.

.5 Splices.

.6 Heat shrink sleeves.

.5 Each controller to be labelled as per use with lamacoid and 1 cm high letters, plus the lamacoid shown below:

HEAT TRACE TO BE ENERGIZED FROM OCTORBER 1 TO MAY 31

2.5 Insulation

.1 Insulation Materials, Recovery Jackets, Vapour Barrier Facings, Tapes and Adhesives.

.1 Composite fire and smoke hazard ratings shall not exceed 25 for flame spread and 50 for smoke developed rating when tested in accordance with CAN/ULC S102, NFPA 255 or ASTM E84.

.2 Provide insulating materials and accessories that withstand service temperatures without smouldering, glowing, smoking, or flaming when tested in accordance with ASTM C441.

.3 All insulation materials shall meet current Building Code Standards, and packages or containers of such materials shall be appropriately labeled.

.4 Insulation (Except Flexible Cellular and Calcium Silicate Insulation):

.1 Place sections of insulation around pipe and joints tightly butted into place. Draw jacket tight and smooth. Secure jacket with fire resistant adhesive, factory-applied self-sealing lap, or stainless steel outward clinching staples spaced not over 4 inches (101.6 mm) on center and 1/2-inch (12.7 mm) minimum from edge of lap. Cover circumferential joints with butt strips, not less than 3 inches (76.2 mm) wide, of material identical to jacket material. Overlap longitudinal laps of jacket material not less than 1-1/2 inches (38.1 mm). Adhesive used to secure butt strip shall be same as that used to secure jacket laps. Apply staples to both edges of butt strips.

.2 Vapor Barrier Jacket: When a vapor barrier jacket is required, on ends of sections of insulation that butt against flanges, unions, valves, fittings, and joints, provide a vapor barrier coating, or manufacturer's weatherproof coating for outside service, unless pipe insulation is supplied with factory-applied self-seal lap. Apply vapor barrier coating at longitudinal and circumferential laps. Patch damaged jacket material by wrapping a strip of jacket material around the pipe and cementing, stapling, and coating as specified for butt strips. Extend patch not less than 1-1/2 inches (38.1 mm) past the break in both directions. At penetrations by pressure gages, thermometers, etc. fill voids with vapor barrier coating (for outside service). Seal with a brush coat of the same coating. (Do not use staples to secure jacket laps on pipes carrying fluid medium at temperatures below 1.7°C (35°F).)

.3 Roof: Where pipe penetrates the roof, insulate piping to a point flush with top of flashing and seal with vapor barrier coating. Butt top of flashing and interior insulation tightly to exterior insulation. Extend exterior metal jacket 2 inches (50.8 mm) to fold down beyond end of insulation. Seal flashing and counterflashing underneath with vapor barrier coating.

.5 Flexible Cellular Insulation (Do not use for pipes in pipe chases and fire walls):

.1 Do not use flexible cellular insulation for pipes in fire rated chases and inside fire walls.

.2 Bond cuts, butt joints, ends, and longitudinal joints with adhesive. Miter 90-degree turns and elbows, tees, and valve insulation. Where pipes penetrate fire walls, provide rated insulation inserts and metal jackets. Insulate flanges, unions, valves, and fittings in accordance with manufacturer's published instructions. Apply two (2) coats finish as recommended by insulation manufacturer to flexible unicellular insulation in outside locations. Do not use vinyl lacquer finish or equivalent. Provide flexible cellular insulation for outdoor use with ultraviolet (UV) resistant coating.

.6 Hangers and Anchors:

.1 Pipe insulation shall be continuous through pipe hangers. Where pipe is supported by insulation, provide galvanized steel shields or protection saddles as indicated.

.2 Where shields are used on pipes 2 inches (50.8 mm) and larger, provide insulation inserts at points of hangers and supports. Insulation inserts shall be of calcium silicate, cellular glass, molded glass fiber, rigid foam or other acceptable material, all minimum 15 psi (103 kPa) compressive strength, of the same thickness as adjacent insulation. Insulation inserts shall cover bottom half of pipe circumference and be not less in length than the protection shield. Vapor-barrier facing of insert shall be of same material as facing on adjacent insulation. Seal inserts into insulation with vapor barrier coating or weatherproof coating as applicable.

.3 Where protection saddles are used, fill voids with same insulation material as used on adjacent pipe. Protection saddles shall not be used on piping carrying medium less than 15.6°C (60°F) unless otherwise indicated.

.4 Where anchors are secured to piping carrying medium less than 15.6°C (60°F) that is to be insulated, insulate anchors same as piping for a distance not less than four times the insulation thickness to prevent condensation. Vapor seal insulation around anchors.

.7 Flanges, Unions, Valves and Fittings for Piping:

.1 Factory fabricated removable and reusable insulation covers may be used except with flexible cellular insulation. When nesting size insulation is used, overlap 2 inches (50.8 mm) or one pipe diameter, whichever is larger. Use insulating cement to fill voids. On pipe sizes larger than 2-1/2 inches (63.5 mm), elbows insulated using insulation segments shall not have less than three segments per elbow. Place and join segments with manufacturer's recommended water-vapor resistant, fire retardant adhesive appropriate for the temperature limit of the service. Overlap tape seams 1 inch (25.4 mm). Total dry film thickness shall be not less than 1/16-inch (1.59 mm). Unions are not to be insulated; taper insulation to union at a 45 degree angle. Provide finish coating as follows:

.2 Coating with Embedded Glass Tape: Coat insulation and all purpose jacket with two coats of lagging adhesive and with glass tape embedded between coats. Total dry film thickness shall not be less than 1/16 inch (1.59 mm). For cold piping, seal insulation and jacket with two coats of vapor barrier coating with glass tape embedded between coats. Insulate anchors attached directly to cold pipe for a sufficient distance to prevent condensation but not less than 6 inches (152.4 mm) from insulation surface.

.3 PVC Fitting Covers: Factory premolded one-piece PVC fitting covers may be provided in lieu of Coating with Embedded Glass Tape. Provide factory premolded field-fabricated segment or blanket insert insulation under fitting covers. Install factory premolded one-piece PVC fitting covers over insulation. Secure covers with stapling, taping with PVC vapor barrier tape, or with metal or plastic tacks made for securing PVC fitting covers. Do not provide PVC fitting covers where exposed to weather. Provide PVC fitting covers only in ambient temperatures below 65.6°C (150°F).

.8 Piping Exposed to Weather:

.1 Metal Jackets: Provide over insulation. Machine cut jacket to smooth edge of circumferential joints. Overlap jacket not less than 2 inches (50.8 mm) at longitudinal and circumferential joints and secure with metal bands at not more than 9 inch (229 mm) centers. Overlap longitudinal joints down to shed water. Seal joints with a coating recommended by insulation manufacturer for weatherproofing.

.2 Flanges, Unions, Valves, Fittings, and Accessories: Insulate and finish as specified hereinbefore for applicable service. Apply two (2) coats of an emulsion type weatherproof mastic for hot service and vapor barrier mastic for cold service recommended by insulation manufacturer. Embed glass tape in the first coat. Overlap tape not less than one inch (25.4 mm) and the adjoining metal jacket not less than 2 inches (50.8 mm).

.9 Insulate fittings and valve bodies with preformed removable insulated fittings.

.10 Cold piping interior: semi-rigid, pre-formed fibreglass or formed rigid mineral fibre pipe insulation, with factory applied paintable canvas vapour barrier jacket, factory moulded to conform with piping, "K" value: maximum 0.035 W/m°C at 24°C. Service temperature: minus 40°C to 150°C.

.11 Cold piping exterior: foamglass insulation with factory applied aluminum vapour barrier jacket, factory moulded to conform with piping. “K” value: maximum 0.035 W/m°C at 24°C. Service temperature: minus 40°C to 150°C.

.12 Recovery jackets: 0.9 mm smooth aluminum sheet or paintable canvas for all new insulated piping.

.13 Vapor Barrier Coating: Provide in accordance with insulation manufacturers’ recommendations.

.14 Vapor Barrier Materials: ASTM C1136. Resistant to flame, moisture penetration, and mold growth, color white.

.15 Weatherproof Coating: For outside applications, provide in accordance with insulation and jacket manufacturer’s recommendations.

.16 PVC Pipe Fitting Cover and Its Vapor Barrier Tape: Provide PVC fitting covers with insulation inserts of same material and thickness as pipe insulation.

2.6 Buried Piping

.1 Provide insulation for all buried piping with a soil cover of less than 2600 mm in grassed areas or less than 3000 mm below roads, walkways, and access pads.

.2 The required insulation shall conform to current CAN/ULC S701 with a minimum compression strength of 175 kPa.

.3 Acceptable Manufacturer:

.1 DOW Chemical HI-40 (blue in colour).

.2 Owens Corning Foamular (400).

.3 Or approved equal.

2.7 Above-ground Piping

.1 Provide insulation for all pipe and equipment with an operating surface temperature in excess of 50°C. Use a minimum thickness of 25 mm. Use greater thicknesses as required to lower the outer skin temperature to below 40°C.

.2 Provide insulation for all piping where heat retention is required, at the locations indicated on the Drawings and for other piping systems where insulation is indicated on the Drawings.

.3 Provide insulation at pipe hangers and supports with factory applied vapour jacket and a self-sealing lap, manufactured specifically for use at support locations. It shall be a minimum of 200 mm long and of the same thickness as adjacent pipe insulation.

.4 Provide a suitable bonding agent to join the preformed sections.

.5 On exterior piping, provide aluminum jacketing with a minimum thickness of 0.9 mm, unless indicated otherwise.

.6 Provide aluminum banding, 12 mm wide by a minimum thickness of 0.5 mm with matching seals.

.7 Provide polypropylene jacketing at elbows, tees or other changes of direction and where indicated. Use the heat-shrink type jacketing, with a minimal thickness of 0.1 mm.

.8 On interior piping, provide paintable canvas jacketing, ULC listed (cUL), 0.27 kg/m^2 minimum.

2.8 Piping Insulation Jackets:

.1 All-Purpose Jackets:

.1 Insulation manufacturer's standard reinforced fire retardent jacket with or without integral vapor barrier as required by the service. Provide jackets in exposed locations with a white surface suitable for field painting.

.2 Metal Jackets:

.1 Aluminum Jackets: ASTM B209, Temper H14, minimum thickness of 27 gage (0.016 inch), with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide smooth surface jackets for jacket outside diameters less than 8 inches (200 mm). Provide corrugated surface jackets for jacket outside diameters 8 inches (200 mm) and larger. Provide stainless steel bands, minimum width of 1/2-inch (12.7 mm). Provide factory prefabricated aluminum covers for insulation on fittings, valves, and flanges. Covers shall be same thickness and material as jackets on adjacent piping.

.2 Stainless Steel Jackets: ASTM A167 or ASTM A240; Type 304, minimum thickness of 33 gage (0.010 inch) (0.254 mm), smooth surface with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide stainless steel bands, minimum width of 1/2-inch (12.7 mm). Provide factory prefabricated stainless steel covers for insulation on fittings, valves, and flanges. Covers shall be same thickness and materials as jackets on adjacent piping.

3. EXECUTION

3.1 Examination

.1 Examine areas and conditions under which pipe tracing cables to be installed and notify Contract Administrator, in writing, of conditions detrimental to proper and timely completion of Work.

.2 Do not install insulation and recovering before piping and equipment has been tested and approved.

.3 Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions.

3.2 Installation

.1 Install in accordance with manufacturer's written instructions. Coordinate installation with pipe insulation application.

.2 Distribute and fasten cable evenly on piping using pipe strap, cable ties, or fibreglass tape at maximum spacing 0.5 m. Ensure that heating cables do not touch or cross each other at any point. Run only cold leads in conduit and ensure sensing bulb does not touch cable. Ground shield to building ground. Coordinate cable installation with insulation application. Loop additional cable at fittings, valves, and flanges.

.3 Provide power connections, end seals, tee kits and all other components required for a complete operating system.

.4 Ensure insulation is continuous through inside walls and floor penetrations. Pack around pipes with fireproof, self-supporting insulation material, properly sealed.

.5 Insulate piping and fittings as noted in the schedule below. Insulate valves unless otherwise noted. Do not insulate unions, flanges (except on flanged valves if valve must be insulated), Victaulic couplings, strainers, (except on chilled water lines), flexible connections and expansion joints. Terminate insulation neatly with plastic material trowelled on a bevel.

.6 Locate insulation or cover seams in least visible locations. Locate seams on piping in ceiling spaces on the underside of the pipe.

.7 Cover all insulated piping throughout with aluminum or paintable canvas recovery jacket secured with aluminum bands on 200 mm centres or screws on 150 mm centres, unless otherwise noted. Lap the joints a minimum of 75 mm. Align longitudinal seams in aluminum recovering to shed water. All bands and screws are to be accessible for service and removal.

.8 Cold piping: seal lap joints with 100% coverage of vapour barrier adhesive. Seal butt joints with 50 mm wide strips of vapour barrier sealed with vapour barrier adhesive. For fittings and valves, apply hydraulic insulating cement; or apply factory fabricated insulation half shells, seal all laps and joints.

.9 Unless indicated otherwise, do not insulate water body valves.

.10 Terminate insulation 100 mm on each side of all flanges and grooved joint couplings.

.11 Finish insulation neatly on hangers, supports, and other protrusions.

.12 Coordinate circuit connection points and voltages with Drawings, make power and control connections.

.13 Apply "electrically traced" signs to outside of thermal insulation as latest CEC Section 62.

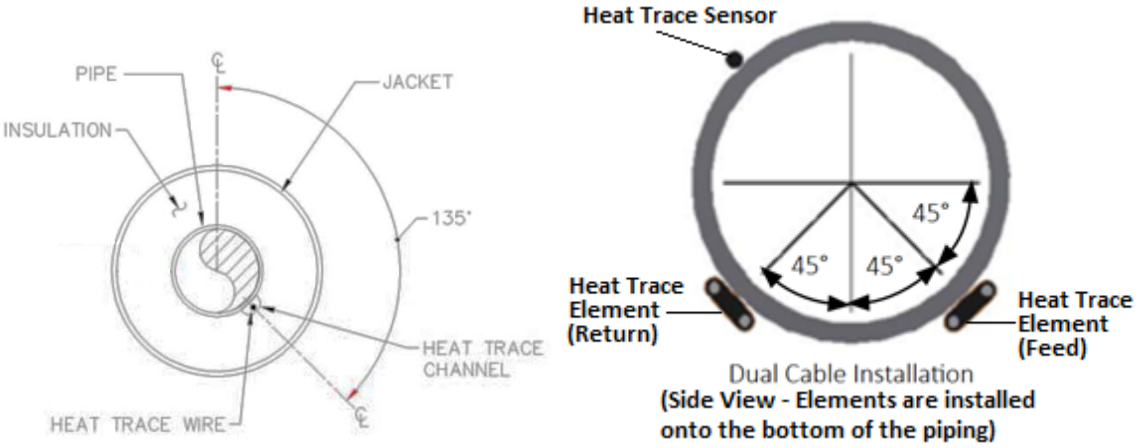
.1 Install heat tracing cable according to circuit length and geometry on approved Shop Drawings. Installation of cable shall conform to the manufacturer’s instructions and the applicable requirements of the Canadian Electrical Code (CEC). Under no circumstances should the length of pull exceed the maximum recommended by the manufacturer.

.2 Written approval of the manufacturer shall be provided in regard to the installation and testing (as outlined herein) of all heat trace cable.

.3 Splicing, branching and terminating of heating cable shall be performed using approved specialized heat shrink kits specifically designed for that purpose and meeting the requirements of the manufacturer.

.4 Install approved end seal kits at cable circuit ends as per the manufacturer's instructions.

.5 Sensors shall be installed on services during construction. Location of sensor must be identified on Shop Drawing submission and consistent with detail drawing of typical hook-up. Must be installed at location representative of ambient temperature on circuit. Location of sensor on pipe should be 180 degrees from heat trace cable (i.e. opposite side of pipe) for single heater element installations. Examples of single and dual elements are shown below for clarity.



.6 Heat trace cable and electrical appurtenances shall be installed in such a manner as to maintain the integrity of and prevent damage to the water pipe, insulation, and the cable itself and its appurtenances.

.7 To facilitate future connections, the Contractor is to provide sufficient length of heat trace cable and thermistor wire in his installations to enable a complete and functional connection.

3.3 Field Quality Control

.1 Examine material at initial install, and again at final installation for damage and defects in workmanship prior to start-up.

.2 Prior to installation of insulation, start pipe tracing system and check for temperature increase over full length of each tracing cable.

.1 A representative of the manufacturer shall megger each circuit of sufficient voltage to confirm whether the circuit will function in its intended manner and is without deficiency. All tests to be witnessed by the Contract Administrator. Each circuit shall be tested before, during and after installation, and the results recorded.

.2 Use 2500 V megger to test cables for continuity and insulation value and record readings before, during and after installation.

.3 Should the resistance drop be in excess of that recommended by the manufacturer of the cable, the Contractor shall determine the cause, rectify same, and re-test the circuit.

.1 Where resistance of 50 megohms or less is measured, stop work and advise Contract Administrator.

.2 Records for the Heat Trace Installation

.1 The Contractor shall provide the Contract Administrator the following records with respect to the construction of the heat trace system and its related controllers:

.1 A Record Drawing of the completed installation showing the location of all terminations, splices, etc. in sufficient detail and accuracy for the Contract Administrator to locate these features in the future. All terminations, splices, etc. shall be tied to a readily identifiable surface feature such as a hydrant, valve, or building face.

.2 A record of each circuit in the heat trace system complete with the appropriate data on circuit length, cable type, and tabulated results of all megger testing.

.3 Submit Operation Manual prepared by the manufacturer(s) of the heat trace system and controls complete with detailed literature on components installed and recommended Operation and Maintenance procedures for the system

3.4 Closeout Activities

.1 Provide in accordance with Division 1.

3.5 Typical Schedules

.1 Refer to the mechanical and process divisions and the drawings for specific requirements. Only when not specified or shown on the drawings carry the minimum materials and requirements as provided in the below Schedules.

SCHEDULE 26 05 95-1, HEAT TRACE APPLICATIONS *				
Application	**Process Fluid, or Piping Size**	**Insulation Thickness (fibreglass) mm**	**Insulation (closed cell phenolic foam)**	**Flow Rate**
Clean Water	Liquid		76mm (3”)	(0.03-USgpm)
Insulated Process Piping, as shown on Drawings	15 to 50 mm (0.6 to 2”)	25mm * (1”)	25mm * (1”)	-
Insulated Process Piping, as shown on Drawings	Over 50mm (2“)	50mm * (2”)	50mm * (2”)	-

SCHEDULE 26 05 95-2, INSULATION MATERIAL FOR PIPING *					
Service	**Material**	**Spec**	**Type**	**Class**	**Vapor Barrier Required**
Chilled Water (Supply & Return, Dual Temperature Piping, 40°F (4.4°C) nominal)	Cellular Glass	ASTM C 552	II	2	No
	Urethane	ASTM C 591			Yes
	Mineral Fiber	ASTM C 547		1	Yes
	Flexible Cellular	ASTM C 534	I		No
	Faced Phenolic Foam	ASTM C 1126	III		Yes
Brine Systems Cryogenics (Minus 30 to Zero deg F) (-34.4 to 17.8°C)	Cellular Glass	ASTM C 552	II	2	No
	Flexible Cellular	ASTM C 534	I		No
	Faced Phenolic Foam	ASTM C 1126	III		Yes
Brine Systems Cryogenics (Zero to 34 deg F) (-17.8 to 1.1°C)	Cellular Glass	ASTM C 552	II	2	No
	Flexible Cellular	ASTM C 534	I		No
	Faced Phenolic Foam	ASTM C 1126	III		Yes

*** Unless stated otherwise elsewhere in the Specifications or on Drawings the values provided here are minimum and considered for information only for preliminary heat tracing estimates. Should other divisions provide more stringent requirements, the more stringent shall govern.**

SCHEDULE 26 05 95-4, INSULATION THICKNESS FOR EQUIPMENT *	
Equipment	**Recommended Thickness**
Expansion Tanks or Pneumatic Water Tanks	1/2" (50.8 mm)
Air Separators	2" (50.8 mm)
Pumps	2" (50.8 mm)
*Chilled Water Tanks 35 to 55°F (1.7 to 12.8°C)	1" (25.4 mm)
*Cryogenic Equipment Minus 30 to 1°F (-34.4 to -17.2°C)	4" (101.6 mm)
NOTE: *indicates where vapor barrier is required.	

*** Unless stated otherwise elsewhere in the Specifications or on Drawings the values provided here are minimum and considered for information only for preliminary heat tracing estimates. Should other divisions provide more stringent requirements, the more stringent shall govern.**

END OF SECTION

ACCEPTANCE TESTING

1. GENERAL

1.1 References

.1 NETA Acceptance Testing Specifications, 2009 (ATS-2009).

.2 CSA C282, Emergency Electrical Power Supply for Buildings.

.3 City of Winnipeg inspection.

1.2 Submittals

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

.2 Submit:

.1 Test equipment to be utilized with last calibration date.

.2 Qualifications of lead electrical inspections technician.

.3 Test forms that will be utilized. These will be based on the COW test form format.

1.3 Qualification

.1 Provide competent lead electrical inspection technician thoroughly familiar with all aspects of electrical testing. It is expected that the technician will have a CET, Journeyman Electrician's certificate, or other equivalent designation. The designated technician is to be on-site and lead all electrical testing.

.1 The Contract Administrator reserves right to approve the lead electrical inspection technician and request an alternate technician if deemed to be unqualified.

.1 The Contract Administrator reserves the right to request documentation and proof from the Contractor that their lead electrical inspections technician is qualified to perform the work. The documentation and proof can include the following:

.2 A request for references from past previous projects.

.3 A request for a list of past previous projects.

.2 In the circumstance where the Contract Administrator rejects the lead inspection technician, the Contractor will be responsible for providing a suitably qualified individual to perform the work, at no additional cost to the City of Winnipeg. Qualifications will be specifically analyzed by the Contract Administrator, based on the following:

.1 The qualified lead electrical inspection technician will have performed similar work at other similar installations.

.2 The qualified lead electrical inspection technician will be trained in using the instruments and measuring devices; and adjusting the settings or programming the devices.

.3 The qualified lead electrical inspection technician will have experience in analyzing the results obtain from the instruments or measuring devices.

.4 The qualified lead electrical inspection technician will have sufficient experience to immediately recognize erroneous measurements based on past work experience and expected results.

.5 The qualified lead electrical inspection technician will be familiar with the settings and methodologies required to perform the work.

.3 In the circumstance where the Contractor cannot provide a competent lead electrical inspection technician, the Contract Administrator reserves the right to hire a qualified individual separate from this Contract and to back charge the Contractor for services and costs performed in order to complete the work.

1.4 Testing Equipment

.1 All test equipment shall be in good mechanical and electrical condition.

.2 Accuracy of metering in test equipment shall be appropriate for the test being performed.

.3 Wave shape and frequency of test equipment output waveforms shall be appropriate for the test and the tested equipment.

.4 The test equipment shall be calibrated as specified below:

.1 The testing organization shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy for each test instrument calibrated.

.2 The testing organization will have calibration certifications for test equipment, and a copy will be made available to the Contract Administrator.

.3 The firm providing calibration service shall maintain up-to-date instrument calibration instructions and procedures for each test instrument calibrated.

.4 Instruments shall be calibrated in accordance with the following frequency schedule:

.1 Field instruments: Analog, 6 months maximum. Digital, 12 months maximum.

.2 Laboratory instruments: 12 months maximum.

.3 Leased specialty equipment: 12 months maximum.

.4 Dated calibration labels shall be visible on all test equipment.

.5 Records, which show date and results of instruments calibrated or tested, must be kept up-to-date.

.6 Calibrating standard shall be of higher accuracy than that of the instrument tested.

.5 Specific requirements of insulation resistance meters.

.1 Must be digital units.

.6 All test equipment to have valid calibration stickers displayed on the equipment.

.7 DC High Pot (dielectric strength) Units:

.1 Test instrument to have minimum output of 60 kV DC capacity.

.2 120 VAC powered.

.8 AC High Voltage (dielectric strength) Units:

.1 Use AC High voltage units for insulation tests and other tests as indicated, at voltage levels indicated, or required by Manufacturers recommendations.

.9 Low Resistance Test Units (Ductor):

.1 Low resistance test units to have 10 A output.

.2 Digital display and accuracy to 1 micro-ohm, with a range from 1 μΩ to 1000 Ω. Standard electrician multimeters will not be accepted.

.10 Insulation Resistance Tests (Megohmmeter/Megger):

.1 Use a megger with 20,000 M-ohm resolution for megger tests.

.2 Output voltages on DC megger units to be 250V, 500V, 1000V, 2500V or other as required.

.3 Record ambient temperature and adjust the measured M-ohms to 20°C ambient.

.4 Use 2.5 kV megger for 5 kV and15 kV equipment and 1000 V megger range for power equipment of 600 V and below.

.5 For 10-minute megger tests, record M-ohm values in M-ohm at 30 seconds, 60 seconds, 5 minutes and 10 minutes. Plot M-ohm against time for each connection, calculate and record the ratio of measured M-ohm as follows:

.1 60 sec M-ohm/30 sec M-ohm = dielectric absorption.

.2 10 min M-ohm/1 min M-ohm = polarization index.

.3 Report the 1 minute M-ohm as the insulation resistance value.

.6 Submit tabulated measure M-ohm figures for 10-minute insulation tests, submit a graph.

.7 Apply megohmmeter dc voltage in accordance with the equipment Manufacturer's recommendations or NETA ATS-2009 Table 100.1.

.11 VLF Test:

.1 Use a VLF tester capable of 40 kV peak that is capable of testing 1.1uF of cable load at 0.1 Hz up to 5.5 uF at 0.2 Hz.

.12 Relay Test Equipment:

.1 Relay test equipment to be designed for relay testing, secondary current injection.

.2 Current output to a minimum of 60Amps for testing of instantaneous features.

.3 Indicators to detect open signals, pick-up signals and other required signals.

.4 Timers to 1 millisecond.

.5 For equipment required on three phase systems, have a three phase voltage and relay output test unit.

.6 For equipment required on three phase differential tests, have a six phase voltage and relay output test unit.

.13 Ground Resistivity Tester:

.1 Ground resistivity tester to measure earth impedance in variable distances from the source.

.2 Unit to be capable of plotting ground resistivity from 0.1 ohms and up.

.14 Other test equipment as required in order to satisfy the requirements of this section as detailed herein.

1.5 Testing Report

.1 Prepare an overall inspection and test report that details all investigations and tests.

.2 The Contractor shall provide final report.

.1 The electronic copy of the report, including the test forms, shall be provided in PDF format.

.2 Sample City test forms are included for reference. The Contractor shall modify the forms, and create new forms as needed to meet all the test requirements described herein.

.3 A Microsoft Word version of the all completed test forms provided to the City shall also be included on the CDs.

.3 The report shall be neat and organized. Any omissions, inconsistencies, or incomplete work identified by the Contract Administrator shall be corrected and incorporated into the report in the appropriate section, and completely resubmitted.

.4 A draft of each report shall be completed and sent to the Contract Administrator for review a maximum of one (1) month after the completion of the inspections at the Site.

.5 The final report shall be submitted a maximum of two (2) weeks after the Contractor receives the mark-up of the draft report from the Contract Administrator.

.6 The report shall include the following:

.1 Summary of project.

.2 Testing Equipment.

.3 Detail the type, manufacturer, model, last calibration date and test certificate for all testing equipment used.

.4 Description of equipment tested.

.5 Description and methodology of all tests performed.

.6 Typed inspection forms including:

.1 Identification of the testing organization.

.2 Equipment identification.

.3 Humidity, temperature, and other conditions that may affect the results of the tests/calibrations.

.4 Date of inspections, tests, maintenance, and/or calibrations.

.5 Identification and signed initials of the testing technician.

.6 Indication of inspections, tests, maintenance, and/or calibrations performed and recorded, along with charts, and graphs as applicable. All measurements and readings taken shall be noted for inclusion in the report. Where repairs are made, measurements and readings before and after the repair shall be included.

.7 Indication of expected results, when calibrations are to be performed.

.8 Indication of “as-found” and “as-left” results, as applicable.

.7 Itemized list of all repaired deficiencies which shall include:

.1 Detailed description of the deficiency.

.2 Detailed description of the deficiency repair.

.8 Itemized list of all un-repaired deficiencies encountered which shall include:

.1 Detailed description of the deficiency.

.2 Recommended action to be taken to repair the deficiency.

.3 Reason for not performing the recommended repair (such as equipment or component not available).

.4 Schedule and subsequent follow up and documentation of the repair of the deficiency.

2. PRODUCTS

2.1 Equipment

.1 Provide all tests results with typed test reports and signed field test sheets.

.2 All test sheets to include equipment nameplate data, customer identification, time and date of tests, environmental conditions during tests, and test results.

.3 Provide testing equipment, lifts, man-baskets, temporary connections, cabling, lugs, leads, clips, and all other devices and equipment as required to perform the required tests and complete the required documentation.

3. EXECUTION

3.1 Test Plan

.1 Prior to performing testing, the lead electrical inspection technician shall submit written test procedures indicating details of the work to be performed to the Contract Administrator for review and approval prior to proceeding.

.2 As a minimum, the test plan shall include the following:

.1 Type of tests.

.2 Equipment being used to perform the test.

.3 Equipment settings for each test.

.4 Test sheets.

.5 Safety checks and safety plan.

.6 An indication of expected results.

.3 The cost of any damage to equipment due to improper test methods or procedures will be borne by the Contractor performing the tests.

3.2 Scope of Testing

.1 Perform testing and Commissioning of electrical devices, in accordance with the Drawings and Specifications to suit the actual project. Scope of work for testing includes the following devices:

.1 Motor Control Centers (MCCs), including:

.1 Surge Protector

.2 Power Meter

.3 Voltage Monitor

.4 CTs

.5 PTs (if present)

.6 Main and Tie Breakers

.7 Branch Circuit Breakers

.8 Motor Starters

.9 VFDs

.10 Interlocks

.11 Kirk keys

.2 Panelboards and distribution panels, greater than 225A, including:

.1 Surge Protector

.2 Power Meter

.3 Voltage Monitor

.4 CTs

.5 PTs

.6 Branch Circuit Breakers

.3 Static Uninterruptible Power Supply (UPS)

.4 Molded case circuit breakers, greater than or equal to 250 A frame.

.5 Contactors, greater than or equal to 100 A.

.6 Protective relays

.7 Dry type transformers, 15 kVA and greater.

.8 Oil filled transformers.

.9 Motors, 0.5 HP and greater.

.10 Safety switches, greater than 200A.

.11 Battery systems.

.12 Surge arrestors.

.13 VFDs.

.14 Cables:

.1 Test all 120 / 208 V / 240 V / 600 V power cables and wires No. 10 AWG or larger (except for lighting and 15A duplex receptacle circuits).

.2 Test all 15 kV cables.

.15 Grounding system.

.16 Perform harmonics measurements and analysis at all main distribution panels, and at all MCCs at all available voltage levels at the Facility.

.2 All equipment which fails the tests shall be replaced, repaired and corrected at no additional charge. These items are deemed to be under warrantee, and the warrantee shall not be affected or voided as a result of the testing performed.

.3 The calibration, check out, testing and Commissioning activities specified in other sections, of the overall Specifications are to be considered as supplemental to the requirements of this section. Those requirements are to be completed for each particular part of the work described prior to the execution of the overall requirements described herein. Where any duplication in requirements may exist the more stringent requirement will take precedent.

.4 Perform Commissioning of all systems, to ensure a complete and functional installation. Perform Commissioning work in accordance with Appendix A – Commissioning Specification and Objectives (CSO), and Appendix B – Commissioning Procedures (CP), of this document.

3.3 Inspection, Testing and Maintenance Procedures

.1 General:

.1 All tests are based on NETA (InterNational Electrical Testing Association) standard ATS-2009. Where Manufacturer's Specifications, tolerances, and/or published data are not available, refer to the appropriate tables in ATS-2009. Confirm with the equipment

Manufacturer that the test will not damage the equipment or void the warrantee prior to proceeding with tests.

.2 Torque all accessible bolted electrical connections. Additional requirements apply as specified.

.3 Utilize the Drawings for reference while performing the specified electrical inspection work. Where the existing installation deviates from that shown on the Drawings, mark-up the Drawings with red pen as required to reflect the installation. Include the marked-up Drawings in the report.

.4 The scope of required Drawing checks is limited to the equipment and components that are part of the electrical inspection work.

.5 Any repairs made that affect the accuracy of the Drawings shall be marked up on the Drawings.

.6 All inspection values, readings, corrections, and assessments shall be clearly recorded for inclusion within the report.

.7 Where corrections or repairs are made, record both as found/as left test readings on the inspection sheet. If space is not provided on the inspection form, record the readings in the Note fields or on a separate sheet.

.2 Inspection Forms:

.1 The inspection forms are to be provided, and completed by the Contractor. These shall be typewritten (in Microsoft Word or Excel format) and submitted the Contract Administrator for format approval.

.2 Make appropriate print-outs of the inspection forms and utilize for entry of data and test results on site.

.3 Utilizing the Microsoft Word form templates, enter the data recorded manually into the forms electronically.

.4 Complete the inspection forms in their entirety and include them in the report.

.5 Submit electronic PDF copies of the inspection forms.

.6 The scope of work required in the Specifications is in no way limited by the inspection forms, or spaces provided. Provide additional pages, documents, and forms as required to provide a complete report.

.7 The inspection forms may be updated during the by the Contract Administrator. Utilize the latest forms.

.8 Perform insulation resistance temperature correction.

3.4 Cables (Also Feeders In Conduit), Up To 600 V

.1 Perform inspection and tests on cables prior to installing sealing compound in the conduit system. This applies to hazardous areas and to weatherproof penetration sealant.

.2 Inspection and testing shall be comprised of the following:

.1 For cables/wires 4/0 AWG or larger, inspect bolted electrical connections for high resistance using a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate and correct values which deviate from those of similar bolted connections by more than 50%of the lowest value.

.2 Torque all accessible bolted electrical connections.

.3 Inspect compression applied connectors for correct cable match and indentation.

.4 Inspect grounding and cable/conduit support.

.5 Verify that visible cable bends meet or exceed the minimum allowable bending radius.

.6 Measure length of cable/conduit and record in meters. Record and adjust all cable lengths included in the cable schedules. Other building base building cabling such as lighting, fire alarm, public address, 15A duplex receptacles do not need to be recorded. Record cable lengths based on conductor distance markings where ever possible, for accurate lengths.

.7 If cables/wires are terminated through window-type current transformers, inspect to verify that neutral and ground conductors are correctly placed and that shields are correctly terminated for operation of protective devices.

.8 Perform an insulation-resistance test on each conductor. Individually test each conductor with all other conductors and shields grounded. The test duration shall be one minute. Investigate resistances less than 1 Gigohms for power cabling. The voltage applied shall be 1000 Vdc for 600 V or 1000 V rated cables.

3.5 Cables, Medium Voltage (5 kV and 15 kV)

.1 Inspection and testing shall be comprised of the following:

.1 Inspect exposed sections of cables for physical damage and evidence of overheating and corona.

.2 Proper connections in accordance with single-line diagram.

.3 Proper circuit and phase identification.

.4 Inspect terminations and splices for physical damage and evidence of overheating and corona.

.5 Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar

connections. Investigate values which deviate from those of similar bolted connections by more than 50% of the lowest value.

.6 Inspect compression applied connectors for correct cable match and indentation.

.7 Check for proper lug installation.

.8 Confirm bolt torque levels are in accordance with Manufacturer's recommendation.

.9 Inspect shield grounding and cable support.

.10 Verify that visible cable bends meet or exceed the minimum allowable bending radius.

.11 Measure and record the length of cable.

.12 If cables are terminated through window-type current transformers, inspect to verify that neutral and ground conductors are correctly placed and that shields are correctly terminated for operation of protective devices.

.13 Perform a shield-continuity test on each power cable by ohmmeter method. The shielding must exhibit continuity. Investigate resistance values in excess of 10 ohms per 1000 feet of cable.

.14 Perform an insulation-resistance test on each conductor utilizing a megohm-meter:

.1 Utilize 2,500-volt megohmmeter for 5 kV, 8 kV, 15 kV conductors in accordance with NETA standards.

.2 Individually test each conductor with all other conductors and shields grounded. The test duration shall be one minute. Investigate resistances less than 5 Gig-ohms for 5 kV cable, and 15 Gig-ohms for 15 kV.

.15 Perform a Very Low Frequency (VLF) ac high-potential test on cables. Adhere to all precautions and limits as specified in the applicable NEMA / ICEA Standard for the specific cable. Perform tests in accordance with IEEE Standard 400.2. Test procedure shall be as follows, and the results for each cable test shall be recorded as specified herein. The test voltage shall be sinusoidal with a frequency of 0.1 Hz, and shall not exceed cable Manufacturer's test values or IEEE 400.2 values as indicated:

Cable rating phase to phase (RMS)	**Acceptance test phase to ground**	**Maintenance test phase to ground**
5 kV RMS	10 kV RMS (14 peak)	7 kV RMS (10 peak)
15 kV RMS	20 kV RMS (28 peak)	16 kV RMS (22 peak)

.1 If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the over-potential test, the test specimen is considered to have passed the test.

.2 Ensure that the input voltage to the test set is regulated.

.3 Current-sensing circuits in test equipment shall measure only the leakage current associated with the cable under test and shall not include internal leakage of the test equipment.

.4 Record wet and dry-bulb temperatures or relative humidity and temperature.

.5 Test each section of cable individually.

.6 Individually test each conductor with all other conductors grounded. Ground all shields.

.7 Terminations shall be adequately corona-suppressed by guard ring, field reduction sphere, or other suitable methods as necessary.

.8 Ensure that the maximum test voltage does not exceed the limits for terminators specified in IEEE Standard 48 or Manufacturer's Specifications.

.9 Raise the conductor test voltage to the specified maximum test voltage and hold for five minutes. Record leakage current.

.10 Apply grounds for a time period adequate to drain all insulation-stored charge.

.16 Perform a Dissipation Factor (Tangent Delta) test on all cables.

.1 Perform tests in accordance with IEEE Standard 400.2.

.2 The test voltage applied shall be a 0.1 Hz sinusoidal waveform.

.3 The dissipation factor shall be calculated for an applied voltage of 1 Uo RMS.

.4 Provided that the dissipation factor does not rise significantly while raising the voltage, the dissipation factor shall also be calculated for an applied voltage 2 Uo RMS.

.5 In the event of a cable failure discovered during testing, replace the cable.

3.6 Circuit Breakers, Insulated-Case/Molded Case, Up To 600 V

.1 Inspection and testing shall include the following:

.1 Note the equipment nameplate data for inclusion in the report.

.2 Record all adjustable settings.

.3 Inspect physical and mechanical condition.

.4 Inspect anchorage and alignment.

.5 Clean the unit.

.6 Torque all accessible bolted power connections.

.7 Operate the circuit breaker to insure smooth operation.

.8 Test all breakers utilizing the “Push-To-Trip” button, if equipped.

.9 Move operating handle to the off and on position.

.10 Restore breaker position to original position.

.2 For cables 4/0 AWG and larger, inspect bolted electrical connections for high resistance using a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50% of the lowest value.

.3 For breakers with a frame size greater or equal to 250 A, or as specified elsewhere in the Specification:

.1 Perform an insulation resistance test.

.2 Breakers rated less than 600 V, test voltage is to be 500 VDC.

.3 Breakers rated at 600 V, test voltage is to be 1000 VDC.

.4 Perform a contact/pole-resistance test.

3.7 Air Circuit Breakers

.1 Visual and Mechanical Inspection:

.1 Proper cell fit and element alignment.

.2 Proper operation of cubicle shutters and racking mechanism.

.3 Bolt torque level in accordance with Manufacturer’s recommendations and NETA ATS-2009, Table 100.12. Where conical washers (Belleville or other) are used, consult with the Contract Administrator prior to tightening or applying pressure to connections.

.4 Proper contact condition.

.5 Perform mechanical operator and contact alignment tests on breaker and it’s operating mechanism in accordance with Manufacturer’s instructions.

.6 Verify primary and secondary contact wipe, gap setting, and other dimensions vital to breaker operations are correct.

.7 Ensure that maintenance devices are available for servicing and operating breaker.

.8 Check for adequate lubrication on contact, moving, and sliding parts.

.9 Check condition of brushes and limit switches on charging and lifting motors.

.10 With Breaker in TEST Position:

.1 Trip and close breaker with control switch.

.2 Trip breaker by manually operating each protective relay.

.11 Perform breaker travel and velocity analysis in accordance with Manufacturer's instructions; values shall be in accordance with Manufacturer's acceptable limits.

.2 Electrical Tests:

.1 Insulation Resistance Tests:

.1 Utilize:

.1 1,000 volt megohmmeter for 600 V circuit breakers.

.2 Pole-to-pole and pole-to-ground with breaker contacts opened for 1 minute.

.3 Pole-to-pole and pole-to-ground with breaker contacts closed for 1 minute.

.4 Test values to comply with NETA ATS-2009 Table 100.1.

.2 Contact Resistance Tests:

.1 Contact resistance in microhms across each pole.

.2 Investigate deviation of 50% or more from adjacent poles and similar breakers.

.3 Dieletric Withstand Tests:

.1 Maximum applied voltage for equipment in accordance with NETA ATS-2009, Table 100.2 and Table 100.19.

.2 Each pole-to-ground with other poles grounded and contacts closed.

.3 Test results evaluated on pass/fail basis.

.4 Minimum pickup voltage tests on trip and close coils.

3.8 Vacuum Circuit Breakers

.1 Visual and Mechanical Inspection:

.1 Check for proper element alignment.

.2 Check for proper operation of cubicle shutters and racking mechanism.

.3 Bolt torque level in accordance with Manufacturer's recommendations and NETA ATS-2009, Table 100.12. Where conical washers (Belleville or other) are used,

consult with the Contract Administrator prior to tightening or applying pressure to connections.

.4 Perform mechanical operational tests on breaker and it's operating mechanism in accordance with Manufacturer's instructions, plus check:

.1 Pull rod adjustment.

.2 Trip latch clearance.

.3 Overtravel stops.

.4 Wipe and gap setting.

.5 Perform breaker travel and velocity analysis in accordance with Manufacturer's instructions; values shall be in accordance with Manufacturer's acceptable limits.

.6 Check contact erosion indicators in accordance with Manufacturer's instructions.

.7 With Breaker in TEST Position:

.1 Trip and close breaker with control switch.

.2 Trip breaker by manually operating each protective relay.

.2 Electrical Tests:

.1 Insulation Resistance Tests:

.1 Utilize 2,500-volt dc megohmmeter for 5 kV and 15 kV circuit breakers.

.2 Pole-to-pole and pole-to-ground with breaker contacts opened for 1 minute

.3 Pole-to-pole and pole-to-ground with breaker contacts closed for 1 minute.

.4 Test values to comply with NETA ATS-2009, Table 100.1

.2 Contact Resistance Tests:

.1 Between the line and load stab of closed contact resistance in microhms across each pole.

.2 Investigate deviation of 50% or more from adjacent poles and similar breakers.

.3 Dielectric Withstand Tests:

.1 Maximum applied voltage in accordance with NETA ATS-2009, Table 100.19.

.2 Each pole-to-ground with other poles grounded and contacts closed.

.3 Test results evaluated on pass/fail basis.

.4 Minimum pickup voltage tests on trip and close coils.

3.9 Contactor Panels, up to 600 V

.1 Inspection and testing shall be comprised of the following:

.1 Note the equipment nameplate data for inclusion in the report.

.2 Inspect physical and mechanical condition.

.3 Inspect anchorage, alignment, and grounding.

.4 Verify the unit is clean.

.5 Torque all accessible bolted power connections.

.6 Inspect unit for evidence of overheating or stress.

.7 Visually inspect and exercise transfer switch.

.2 If power and/or control fuses are present, record fuse size and type. Measure the resistance of each fuse. Investigate inconsistent resistance values.

.3 Perform an insulation resistance tests.

.1 Units rated less than 600 V, test voltage is to be 500 VDC.

.2 Units rated at 600 V, test voltage is to be 1000 VDC.

.4 Perform a contact/pole-resistance tests.

.5 Perform functional testing to verify operation of unit.

3.10 Control Power Transformers, up to 600 V

.1 Inspection and testing shall be comprised of the following:

.1 Record the equipment nameplate data for inclusion in the report.

.2 Inspect physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.

.3 Verify that primary and secondary fuse ratings or circuit breakers match available Drawings. Where Drawings are not available, note fuses that appear to be sized incorrectly, based upon application of the Canadian Electrical Code. Mark fuse sizes and type on the Drawings, where not shown.

.4 Perform insulation-resistance tests. Perform measurements from winding-to-winding and each winding-to-ground. Test voltages shall be:

.1 windings less than 250 V: 500 VDC.

.2 windings greater than 250 V: 1000 VDC.

3.11 Current Instrument Transformers

.1 Inspection and testing shall be comprised of the following:

.1 Inspect physical and mechanical condition.

.2 Record the equipment nameplate data for inclusion in the report.

.3 Ensure that CT shorting bars are removed or installed as required.

.4 Verify that current circuits are grounded and have only one grounding point in accordance with ANSI/IEEE C57.13.3.

.5 Perform an insulation resistance test of the current transformer primary and secondary windings, and wiring to ground at 1000 VDC. Do not perform this test on solid-state devices. Investigate any resistance values less than 25 megohms.

.6 Perform a polarity test of each current transformer in accordance with ANSI/IEEE C57.13.1.

.7 Perform a ratio-verification test using the voltage or current method in accordance with ANSI/IEEE C57.13.1. Note any ratio accuracies not within 0.5% of nameplate or Manufacturer's published data.

.8 Perform an excitation test on transformers used for protection or relaying applications in accordance with ANSI C57.13.1.

3.12 Grounding System

.1 Inspection and testing shall be comprised of the following:

.1 Perform resistance tests between the main grounding electrode and grounded points in the electrical distribution system located in the switchgear, transformers, and MCCs. Investigate and correct connections with a resistance greater than 0.5 milliohms.

.2 Perform resistance tests between the main grounding electrode and grounded points in the isolated ground system points in all control / PLC cabinets connected to the isolated ground system. Investigate and correct connections with a resistance greater than 0.5 milliohms.

.3 Perform resistance tests between the lightning protection terminals (at roof level) and the grounding electrode. Investigate and correct connections with a resistance greater than 0.5 milliohms.

3.13 Protective Relays

.1 Visual and Mechanical Inspection:

.1 Visually Check Each Relay For:

.1 Tight cover gasket and proper seal.

.2 Unbroken cover glass.

.3 Condition of case shorting contacts if present.

.4 Circuit wiring and connections

.2 Mechanically Check Each Relay For:

.1 Freedom of movement.

.2 Proper travel and alignment.

.3 Trip plunger mechanism.

.3 Verify That Each Relay:

.1 Complies with Contract Documents and application.

.2 Is set in accordance with recommended settings.

.2 Electrical Tests:

.1 Tests on Nominal Recommended Setting For:

.1 Perform tests to suit the type of relay and the type of protection in accordance with NETA ATS-2009.

.2 Pickup parameters on each operating element.

.3 Timing at three points on time-current curve.

.4 Pickup target and seal-in units.

.5 Special tests as required to check operation of restraint, directional, and other elements in accordance with Manufacturer's instruction manual and NETA standards.

.2 Phase angle and magnitude contribution tests on differential and directional relays after energization to vectorially verify proper polarity and connections.

.3 Current Injection Tests:

.1 For entire current circuit in each section.

.2 Secondary injection for current flow.

.3 Test current at each device.

.4 For Motor protection Relays and similar relays, use 3-phase current injection for unbalanced protection testing, unless recommended otherwise by the Manufacturer.

.5 Use 6 phase current injection and voltage relay (3 phase line, 3 phase load) test units for differential protection relays.

3.14 Metering Devices, Digital

.1 Inspection and testing shall be comprised of the following:

.1 Inspect physical and mechanical condition.

.2 Torque all bolted connections.

.3 Record the equipment nameplate data for inclusion in the report.

.4 Verify accuracy of voltage and current at a minimum of two points each.

.5 If required, calibrate meters in accordance with Manufacturer's published data.

3.15 Panelboards, up to 600 V

.1 Inspection and testing shall be comprised of the following:

.1 Note the equipment nameplate data for inclusion in the report.

.2 Inspect physical and mechanical condition.

.3 Inspect anchorage, alignment, and grounding.

.4 Clean the unit.

.5 Inspect breakers and verify mechanical operation by exercising all circuit breakers.

.1 Record breaker data on the inspection form.

.2 Test all breakers utilizing the "Push-To-Trip" button, if equipped.

.3 Move operating handle to the off and on position.

.4 Restore breaker position to original position.

.6 Test with current injection, main and feeder/load breakers with a frame size greater than or equal to 250A, or with long, short, or ground fault settings and complete a separate inspection form for each.

.7 Torque all accessible bolted power connections including incoming, load neutral and ground connections.

.8 Perform insulation-resistance tests on each bus phase with all other phases grounded.

.1 The main breaker, if present, is to be open for the test. If no main breaker is present, disconnect the supply conductors.

.2 Open all load breakers.

.3 Test voltage for all 600/347 V panelboards to be 1000 VDC.

.4 Test voltage for all 120/208 V panelboards to be 500 VDC.

3.16 Motor Control, up to 600 V

.1 Visual and Mechanical Inspection:

.1 Proper barrier and shutter installation and operation.

.2 Proper operation of indicating and monitoring devices.

.3 Proper overload protection for each motor.

.4 Improper blockage of air-cooling passages.

.5 Proper operation of drawout elements.

.6 Integrity and contamination of bus insulation system.

.7 Check Door and Device Interlocking System By:

.1 Closure attempt of device when door is in OPEN position.

.2 Opening attempt of door when device is in CLOSED position.

.8 Check Key Interlocking Systems For:

.1 Key captivity when device is in CLOSED position.

.2 Key removal when device is in OPEN position.

.3 Closure attempt of device when key has been removed.

.4 Correct number of keys in relationship to number of lock cylinders.

.5 Existence of other keys capable of operating lock cylinders; destroy duplicate sets of keys.

.9 Check Nameplates for Proper Identification of:

.1 Equipment title and tag number with latest one-line diagram.

.2 Pushbuttons.

.3 Control switches.

.4 Pilot lights.

.5 Control relays.

.6 Circuit breakers.

.7 Indicating meters.

.10 Verify that fuse and circuit breaker sizes and types conform to the Drawings.

.11 Verify that current and potential transformer ratios conform to the Drawings.

.12 Check Bus Connections for High Resistance by Low Resistance Ohmmeter, Calibrated Torque Wrench Applied to Bolted Joints and Thermographic Survey:

.1 Ohmic value to be zero.

.2 Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by Manufacturer.

.3 Thermographic survey temperature gradient of 2°C, or less.

.13 Check Operation and Sequencing of Electrical and Mechanical Interlock Systems By:

.1 Closure attempt for locked open devices.

.2 Opening attempt for locked closed devices.

.3 Key exchange to operate devices in OFF-NORMAL positions.

.14 Verify performance of each control device and feature furnished as part of the motor control center.

.15 Control Wiring:

.1 Compare wiring to local and remote control, and protective devices with elementary diagrams.

.2 Check for proper conductor lacing and bundling.

.3 Check for proper conductor identification.

.4 Check for proper conductor lugs and connections.

.16 Exercise active components.

.17 Inspect Contactors For:

.1 Correct mechanical operations.

.2 Correct contact gap, wipe, alignment, and pressure.

.3 Correct torque of all connections.

.18 Compare overload heater rating with full-load current for proper size.

.19 Compare, fuse, motor protector, and circuit breaker with motor characteristics for proper size.

.20 Perform phasing check on double-ended motor control centers to ensure proper bus phasing from each source.

.2 Electrical Tests:

.1 For units with solid state components, follow Manufacturer's recommendations prior to performing any tests.

.2 Insulation Resistance Tests:

.1 Applied megohmmeter dc voltage.

.2 Bus section phase-to-phase and phase-to-ground for 1 minute on each phase.

.3 Contactor phase-to-ground and across open contacts for 1 minute on each phase.

.4 Starter section phase-to-phase and phase-to-ground on each phase with starter contacts closed and protective devices open.

.5 Test values to comply with NETA ATS-2009, Table 100.1.

.3 Current Injection Through Overload Unit at 300% of Motor Full-Load Current and Monitor Trip Time:

.1 Trip time in accordance with Manufacturer's published data.

.2 Investigate values in excess of 120 seconds.

.4 Control Wiring Tests:

.1 Apply secondary voltage to control power and potential circuits.

.2 Check voltage levels at each point on terminal boards and each device terminal.

.5 Operational test by initiating control devices to affect proper operation.

.6 Verify the correct operation of the network cabling, network switch, and associated components within Smart MCCs.

.1 Verify I/O and metering data from each Intelligent Overload.

3.17 Motors, Induction, AC, up to 600 V

.1 Inspection and testing shall be comprised of the following:

.1 Note the equipment nameplate data for inclusion in the report.

.2 Inspect physical and mechanical condition.

.3 Inspect anchorage, alignment, and grounding.

.4 Inspect air baffles, filter media, cooling fans, slip rings, brushes, and brush rigging. Air baffles and filter media should be clean. Cooling fans should operate. Slip ring wear and brushes should be within Manufacturer's tolerances for continued use. Brush rigging should be intact.

.5 Inspect bolted electrical connections for high resistance using a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50% of the lowest value.

.6 Verify the application of appropriate lubrication and lubrication systems.

.7 Verify the absence of unusual mechanical or electrical noise or signs of overheating.

.8 Perform a rotation test to insure correct shaft direction.

.9 Perform insulation-resistance tests in accordance with ANSI/IEEE Standard 43. Test voltage shall be in accordance with Manufacturer's published data or 500 Vdc.

.1 Where possible, test each winding separately. Ground all windings not under test.

.2 Ensure all cables and accessories are disconnected during the test.

.3 For motors less than or equal to 150kW (200 HP), the test duration is to be one (1) minute. Calculate the dielectric absorption ratio.

.4 For motors greater than 150kW (200 HP), the test duration is to be ten (10) minutes. Calculate the dielectric absorption ratio and polarization index.

.5 Correct test results to 40°C.

.6 Investigate readings below 100 megohms. Investigate dielectric absorption ratios less than 1.4 and polarization index ratios less than 2.0 for Class B insulation and Class F insulation.

.10 Where it is not possible to perform an insulation resistance test separately on each winding, perform a winding resistance test on each winding using a low-resistance ohmmeter.

.11 Measure running voltage and current and evaluate relative to load conditions and nameplate full-load amperes. Utilize a true RMS meter.

.1 Where powered by a VFD with bypass, perform test with the motor powered by the VFD and by the bypass starter.

.12 Perform insulation-resistance test on insulated bearings in accordance with Manufacturer's published data, if applicable.

.13 Perform resistance tests on resistance temperature detector (RTD) circuits. RTD circuits should conform to design intent and/or machine protection device Manufacturer's Specifications.

3.18 Safety Switches, up to 600 V

.1 Visual and Mechanical Inspection:

.1 Proper blade pressure and alignment.

.2 Proper operation of switch operating handle.

.3 Adequate mechanical support for each fuse.

.4 Proper contact-to-contact tightness between fuse clip and fuse.

.5 Cable connection bolt torque level in accordance with NETA ATS-2009, Table 100.12.

.6 Proper phase barrier material and installation.

.7 Verify that fuse sizes and types correspond to one-line diagram.

.8 Perform mechanical operational test and verify electrical and mechanical interlocking system operation and sequencing where installed.

.2 Electrical Tests:

.1 Insulation Resistance Tests:

.1 Applied megohmmeter dc voltage.

.2 Phase-to-phase and phase-to-ground for 1 minute on each pole.

.3 Insulation resistance values equal to, or greater than, ohmic values established by Manufacturer.

.2 Contact Resistance Tests:

.1 Contact resistance in microhms across each switch blade and fuse holder.

.2 Investigate deviation of 50% or more from adjacent poles or similar switches.

3.19 Motor Starters, up to 600 V

.1 Inspection and testing shall be comprised of the following:

.1 Note the motor / equipment nameplate data for inclusion in the report.

.2 Record all adjustable settings, size of overload, etc.

.3 Ensure overloads are set in accordance with the motor nameplate data, and the electrical code requirements.

.4 Inspect physical and mechanical condition.

.5 Inspect anchorage, alignment, and grounding.

.6 Verify the unit is clean.

.7 Torque all accessible bolted power connections.

.8 Inspect contactors for evidence of overheating or stress.

.9 Visually inspect and exercise circuit breaker.

.10 If power fuses are present, record fuse size and type. Measure the resistance of each fuse. Investigate inconsistent resistance values.

3.20 Motor Starters, Soft Starter, up to 600 V

.1 Inspection and testing shall be comprised of the following:

.1 Note the motor / equipment nameplate data for inclusion in the report.

.2 Confirm soft starter parameters.

.3 Ensure all parameters are correct for the specific motor nameplate.

.4 Record size and setting of overload.

.5 Inspect physical and mechanical condition.

.6 Inspect anchorage, alignment, and grounding.

.7 Verify the unit is clean.

.8 Torque all accessible bolted power connections.

.9 Inspect contactors for evidence of overheating or stress.

.10 Perform resistance measurements with a low-resistance ohmmeter for each pole of the following:

.1 Bypass contactor.

.2 Capacitor contactor, if applicable.

.3 Main disconnect/circuit breaker.

.4 Main fuses.

.11 Perform power cable insulation resistance measurements. Test voltage for 208 V or 240 V to be 500 V, 600 V rated equipment is to be 1000 V. Disconnect the power cables from the soft starter module and control power fuses prior to test. Test to include:

.1 Bypass contactor line and load to GND.

.2 Bypass contactor line to load with contactor open.

.12 Perform an operational inspection while starting, running, and stopping the motor at normal load. Include:

.1 Measurement of ramp up time.

.2 Measurement of motor current.

.3 Recording of soft starter, ammeter, and remote displayed current readings.

.4 Measurement of ramp down time.

3.21 Variable Frequency Drive, Low Voltage (less than 37.5 kW)

.1 Inspection and testing shall be comprised of the following:

.1 Inspect physical and mechanical condition.

.2 Inspect anchorage, alignment, and grounding.

.3 Clean the unit.

.4 Check the air filters.

.5 Ensure vent path openings are free from debris and that heat transfer surfaces are not contaminated by oil, dust, or dirt.

.6 Verify correct connections of circuit boards, wiring, disconnects, and ribbon cables.

.7 Visually inspect VFD grounding to ensure continuity.

.8 Inspect condition and connections of line reactors, and load reactors / load filter if present.

.9 Inspect DC bus capacitors for bulging and leakage.

.10 Cooling fans and heat sinks:

.1 Visually inspect and listen for any abnormal noises or vibration.

.2 Verify that fans rotate freely.

.3 Verify correct direction of airflow.

.4 Clean and verify integrity of heat sinks.

.5 Verify the operation of the grounding switch, if present.

.11 Perform all other work in accordance with the Manufacturer's instructions.

.2 Record the following VFD Parameters:

.1 Motor voltage, current, frequency, nominal speed, nominal power.

.2 Control mode / method.

.3 Minimum and maximum control frequency.

.4 Acceleration and deceleration time.

.5 Compare drive overcurrent set points with motor full-load current rating to verify correct settings.

.3 Power fuses:

.1 Record fuse data. Confirm that the fuses are of the correct type and rating. Utilize Manufacturer's published data where available.

.2 Measure fuse resistance.

.4 Bolted connections:

.1 Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50% of the lowest value.

.2 Torque all bolted connections.

.5 Inverter / Supply Module Power Connections:

.1 Remove each power module and visually inspect the contacts.

.2 Torque all cable connections.

.3 Clean all contact surfaces and apply suitable joint compound as recommended by Manufacturer.

.6 Operator Interface:

.1 Check the display and keypad for proper operation and communication.

.2 Retrieve fault history log and note any faults.

.7 Grounding/Bonding measurements:

.1 Measure the resistance of the ground bonding connection between the VFD and the main grounding bus in the corresponding electrical room.

.8 Control Wiring:

.1 Check for tightness of all accessible control wiring and torque any loose connections.

.9 Perform operational tests by initiating control devices.

.1 Slowly vary drive speed between minimum and maximum. Observe motor and load for unusual noise or vibration.

.2 Verify operation of drive from local start/stop and speed control signals.

.3 Verify operation of all local pilot lights.

.4 Verify the operation of any emergency stop switches.

.5 Perform all other tests in accordance with the Manufacturer's instructions.

.6 Perform all tests in accordance with the Manufacturer's recommendations and instructions.

.10 Voltage and Current Testing:

.1 With the VFD under load, measure and record the following:

.1 Incoming AC voltage and currents.

.11 With the VFD output in START/RUN mode, and at zero speed:

.1 Measure and record the AC output voltage. Voltages above 40 VAC should be investigated.

3.22 Surge Arrestors, up to 600 V

.1 Inspection and testing shall be comprised of the following:

.1 Inspect physical and mechanical condition.

.2 Inspect anchorage, alignment, grounding, and required clearances.

.3 Clean the unit.

.4 Verify that arrestors are electrically connected in their specified configuration.

.5 Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50% of the lowest value.

.6 Verify that the ground lead on each device is individually attached to a ground bus or ground electrode.

.7 Verify that stroke counter, if present, is correctly mounted and electrically connected.

.8 Perform insulation-resistance tests for one minute from each phase terminal to the case.

.9 Equipment rated greater than or equal to 600 V, utilize a test voltage of 1000 VDC.

.10 Equipment rated less than 600 V, utilize a test voltage of 500 VDC.

.11 Test the grounding connection. Resistance between the arrester ground terminal and the ground system should be less than 0.5 ohm.

3.23 Transformers, Dry-Type, up to 600 V

.1 Inspection and testing shall be comprised of the following:

.1 Note the equipment nameplate data for inclusion in the report.

.2 Inspect physical and mechanical condition.

.3 Inspect anchorage, alignment, and grounding.

.4 Clean the unit.

.5 Torque all accessible bolted power connections.

.6 Record the tap setting.

.7 Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Duration of the test is to be one minute. Calculate the dielectric absorption ratio.

.1 600 V windings shall be tested at 1000 VDC.

.2 120/208 V windings shall be tested at 500 VDC.

3.24 Transformers, Dry-Type, Medium Voltage

.1 Inspection and testing shall be comprised of the following:

.1 Note the equipment nameplate data for inclusion in the report.

.2 Inspect physical and mechanical condition.

.3 Inspect anchorage, alignment, and grounding.

.4 Clean the unit.

.5 Verify that alarm settings on temperature indicators are as specified and operate within Manufacturer's recommendations for specified settings.

.6 Inspect bolted electrical connections for high resistance using a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50% of the lowest value.

.7 Record tap setting. Confirm the tap setting appears reasonable by measuring the voltage during normal Facility operation.

.8 Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Calculate polarization index. Minimum insulation-resistance values of transformer insulation should be 1000 megohms for the 4160 V windings and 100 megohms for the 600 V windings. Values of insulation resistance less than the values stated should be investigated. The polarization index should not be less than 1.0.

.1 The test duration shall be 10 minutes for each winding.

.2 4160 V windings shall be tested at 2500 VDC.

.3 600 V windings shall be tested at 1000 VDC.

.9 Perform turns-ratio tests at the designated tap position. Turns-ratio test results should not deviate more than one-half percent from either the adjacent coils or the calculated ratio.

.10 Measure the resistance of each winding at the designated tap position.

.11 Measure core insulation resistance at 500 VDC if the core is insulated and if the core ground strap is removable.

.12 Verify correct secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading. Phase-to-phase and phase-to-neutral secondary voltages should be in agreement with nameplate data.

3.25 Liquid Filled Transformers

.1 Inspection and testing shall be comprised of the following:

.1 Physical and insulator damage.

.2 Conduct external inspections in accordance with layout Shop Drawings. Check nameplates and vector diagrams against test results.

.3 Inspect silica gel breathers, oil gauge, temperature gauge and similar devices where fitted. For devices with settings, record the settings in use. Record actual reading of all gauges and ambient temperature.

.4 Proper winding connections.

.5 Bolt torque level in accordance Manufacturer's recommendations.

.6 Defective wiring.

.7 Proper operation of fans, indicators, and auxiliary devices.

.8 Effective core and equipment grounding. Review neutral grounding device wiring and connections (if present).

.9 Removal of shipping brackets, fixtures, or bracing.

.10 Inspect for oil leaks, correct oil level, and sign of rusting.

.11 Integrity and contamination of bus insulation system.

.12 Verify that tap-changer is set at correct ratio for rated voltage under normal operating conditions.

.13 Verify proper secondary voltage phase-to-phase and phase-to-ground after energization and prior to loading.

.14 Exercise the manual tap changer to check its functions and ease of access.

.15 Operate and simulate alarm and trip conditions of each protective device.

.2 Electrical Tests:

.1 As a minimum, perform the following transformer tests:

.1 Perform high voltage AC insulation tests on high voltage windings to ground, low voltage windings to ground, high voltage windings to low voltage windings. Perform dobble test on transformer, approved equal in accordance with B8 Capacitance and Dissipation Factor tests.

.2 Inspect bushings, and measure insulation resistance with use of high voltage AC insulation test.

.3 Winding resistance measurement on all windings (standard test protocol).

.4 Oil analysis and gas analysis.

.5 H.V. test on oil samples from transformer tank for each transformer.

.6 Voltage ratio three phase, for each tap (Transformer Tap ratio).

.7 Relay and protective devices operation.

.2 Insulation Resistance Tests:

.1 Applied megohmmeter dc voltage for each:

.2 Winding-to-winding.

.3 Winding-to-ground.

.4 10-minute test duration with resistances tabulated at 30 seconds, 1 minute, and 10 minutes. Results temperature corrected in accordance with NETA ATS-2009, Table 100.14 or Tables 260805-1 and 260805-1.

.5 Temperature corrected insulation resistance values equal to, or greater than, ohmic values established by Manufacturer.

.6 Insulation resistance test results to compare within 1% of adjacent windings.

.3 Perform tests and adjustments for fans, controls, and alarm functions as suggested by Manufacturer.

3.26 Grounding Systems

.1 Visual and Mechanical Inspection:

.1 Equipment and circuit grounds in motor control center, panelboard, switchboard, and switchgear assemblies for proper connection and tightness.

.2 Ground bus connections in motor control center, panelboard, switchboard, and switchgear assemblies for proper termination and tightness.

.3 Effective transformer core and equipment grounding and bonding.

.4 Accessible connections to grounding electrodes for proper fit and tightness.

.5 Accessible exothermic-weld grounding connections to verify that moulds were fully filled and proper bonding was obtained.

.2 Electrical Tests:

.1 Fall-Of-Potential Test:

.1 In accordance with IEEE 81, Section 8.2.1.5, perform measurements of the ground system resistance, at each Facility, and at the substation.

.2 The ground system resistance shall not exceed 0.5 ohms in summer soil conditions.

.3 Test point shall be at the North-West corner of the substation, plus at each of the individual buildings.

.4 Perform resistance testing of the connections between each ground rod and ground cabling, to ensure proper connection.

3.27 Ground Fault Systems

.1 Inspection and Testing Limited To:

.1 Zero sequence grounding systems.

.2 Residual ground fault systems.

.2 Visual and Manual Inspection:

.1 Neutral Main Bonding Connection to Assure:

.1 Zero sequence sensing system is grounded ahead of neutral disconnect link.

.2 Ground strap sensing system is grounded through sensing device.

.3 Neutral ground conductor is solidly grounded.

.2 Verify that control power has adequate capacity for system.

.3 Manually Operate Monitor Panels For:

.1 Trip test.

.2 No trip test.

.3 Nonautomatic rest.

.4 Zero sequence system for symmetrical alignment of core balance transformers about current carrying conductors.

.5 Relay check for pickup and time under simulated ground fault conditions.

.6 Verify nameplate identification by device operation.

3.28 Thermographic Inspection

.1 Camera

.1 Minimum IR resolution: 320 x 240 pixels.

.2 Minimum visible resolution: 640 x 480 pixels.

.2 Thermographic inspections and photographs shall be completed in accordance with the recommendations of the Standard for Infrared Inspection of Electrical Systems and Rotating Equipment published by the Infraspection Institute.

.3 Provide a thermographic survey of connections associated with incoming service conductors, bus work, and branch feeder conductors and larger at each:

.1 Medium voltage switchgear.

.2 Low voltage switchgear, greater than 225A

.3 Panelboards greater than 225A.

.4 Motor control centers.

.5 Transfer switches.

.6 All other equipment specified herein which requires a thermographic survey.

.4 Provide a thermographic survey of feeder conductors terminating at:

.1 Motors rated 50 HP and larger.

.2 Transfer switches.

.3 Engine-generators.

.5 Inspection and testing shall be comprised of the following:

.1 Remove all necessary covers prior to thermographic inspection.

.2 Equipment to be inspected shall include all current-carrying devices.

.3 Test Parameters:

.1 Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1°C at 30°C.

.2 Equipment shall detect emitted radiation and convert detected radiation to a visual signal.

.3 Thermographic surveys should be performed during periods of maximum possible loading but not less than 40% of rated load of the electrical equipment being inspected. Coordinate with City as required.

.4 Note all temperature differences larger than 1°C. Investigate all temperature differences larger than 4°C.

.5 Re-inspect deficient areas with the thermographic camera following repairs and corrections, for deficient areas identified.

.6 Provide a report which shall include the following:

.1 Description of the equipment tested.

.2 Discrepancies found.

.3 Temperature difference between the area of concern and the reference area. Probable cause of temperature difference. Identify any repairs made during the thermographic inspection. If no repairs were made, provide recommended action for repair.

Areas inspected. Identify inaccessible and / or unobservable areas and / or equipment.

.4 Identify load conditions at time of inspection.

.5 Provide photographs and thermograms of all areas investigated, with deficient areas identified. Visible light photographs and thermograms shall align in a manner to allow for easy identification of the components shown on the thermograms.

.6 Provide thermograms of all deficient areas corrected and identify the load conditions at the time of re-inspection.

END OF SECTION

1. GENERAL

1.1 Related Sections

.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section. This section supplements requirements of other Divisions.

.1 Section includes various equipment and testing requirements that may be required for the project and the applications where each type shall be used.

1.2 Description

.1 This section covers the furnishing of all materials, equipment and services for the design, fabrication, supply and delivery, installation/labour, and testing of indoor transformers, or outdoor pad-mounted transformers.

.2 This specification outlines only general performance and minimum requirements; it is not intended to relieve the Vendor of responsibility for the design of equipment in accordance with the latest applicable codes and standards.

.3 The intent of this specification is to convey minimum requirements for complete, operable, safe, effective and approved equipment delivered to the site ready for installation.

1.3 References

.1 American National Standards Institute (ANSI):

.1 C57. 12.90: Test Code for Distribution and Power Transformers.

.2 Canada Energy Efficiency Act and Energy Efficiency Regulations:

.1 National Resources Canada (NRCan).

.3 Canadian Standards Association (CSA):

.1 CSA C9, Dry-Type Transformers.

.2 CSA C22.1, Canadian Electrical Code Part I (CEC) as amended by provincial, territorial or municipal authority having jurisdiction. References to CEC/MEC elsewhere in this document shall include reference to such amendments.

.3 CSA C22.2 No.47, Air-Cooled Transformers (Dry Type).

.4 CSA C22.3 No.7, Underground Systems.

.5 CSA C802.2, Minimum Efficiency Values for Dry Type Transformers.

.4 Institute of Electrical and Electronics Engineers (IEEE):

.1 C57.12.28: Standard for Pad-Mounted Equipment - Enclosure Integrity.

.5 Manitoba Energy Code for Buildings (MECB):

.1 Manitoba amendments to the National Energy Code of Canada for Buildings.

.6 National Electrical Testing Association (NETA):

.1 ATS – Acceptance Testing Specifications for Electrical Power Equipment and Systems.

.7 National Electrical Manufacturers Association (NEMA):

.1 ST 20, Dry Type Transformers for General Applications.

.8 Winnipeg Electrical By-law (WEB):

.1 Winnipeg amendments to the Canadian Electrical Code (CEC).

.9 Winnipeg Building By-law (WBB):

.1 Winnipeg amendments to the National Building Code of Canada (NBC).

1.4 Warranty

.1 As a minimum, the Vendor shall include a warranty for 12 months of operation or 18 months after arrival on site, whichever is less. The Vendor shall state their standard warranty for the Transformer specified.

1.5 Submittals

.1 Submit in accordance with Division 1 and Division 26.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature, specifications, and data sheets for dry type transformers and include product characteristics, performance criteria, physical size, impedance, finish and limitations. Include transformer weight.

.3 For wall-mount installations coordinate the support structure with other divisions and submit for review.

.4 Closeout Submittals

.1 Operation and Maintenance Data: For transformers to include in operation and maintenance (O&M) manuals.

.2 Applicable wiring diagrams, including any modifications.

.3 Performance Validation Report and other completed factory and site testing reports.

.5 Outdoor installations:

.1 Submit catalogue cuts for transformer pads, including anchoring method and dimensioned foundation template. Provide dimensioned cable entry locations.

1.6 Responsibility

.1 Install transformers, factory-supplied materials, accessories, and options, furnished by the transformer manufacturer.

1.7 Quality and Environmental Assurance

.1 On-Site Testing Qualifications: Accredited by NETA.

.2 Certified ISO 9001 Quality Management System.

.3 Certified ISO 14001 Environmental System.

2. PRODUCTS

2.1 General

.1 General: dry type, air-cooled, self-ventilated, code gauge steel, complete with ventilation openings, removable access panels, mounting brackets, and solderless primary and secondary cable connectors. Enclosures to have zinc chromate prime coat and enamel finish coat per Division 26. Transformers to be single- or 3-phase as noted on the Drawings.

.2 Design:

.1 Type: Air Natural Convection Cooling (ANN).

.2 CSA/NEMA Environmental Rating: minimum 3R, with removable metal front panel.

.1 When installed Indoors suitable for an ambient temperature of: 5˚C to 30˚C, ventilated.

.2 When installed Outdoors suitable for an ambient temperature of: -40˚C to 40˚C, of fully enclosed non-ventilated design, or shielding plates to prevent ingress from snow drifts.

.3 3-phase, kVA and voltages as indicated on the Drawings, 60 Hz.

.4 Voltage primary taps: 2.5% full capacity above and below normal.

.5 Insulation: Class H.

.6 Basic Impulse Level (BIL): 10 kV B.I.L.

.7 Hipot: 4 kV.

.8 Low-Sound-Level Requirements: Maximum sound levels when factory tested according to NEMA ST 20, applied to all transformers, including those with K-factor ratings up to 20, as follows:

.1 9.00 kVA and Less: 40 dBA.

.2 9.01 to 30.00 kVA: 42 dBA.

.3 30.01 to 50.00 kVA: 42 dBA.

.4 50.01 to 150.00 kVA: 47 dBA.

.5 150.01 to 300.00 kVA: 52 dBA

.6 300.01 to 500.00 kVA: 57 dBA.

.7 500.01 to 700.00: 59 dBA.

.8 700.01 to 1000.00: 61 dBA.

.9 1000.01 to 1500.00 kVA: 64 dBA.

.9 Factory Sound-Level Tests: Conduct sound level tests on equipment. Provide data for each serial number upon request.

.10 Test each transformer for required noise limit. Type testing is not acceptable.

.11 Impedance at 170°C: 6.0% maximum up to 112.5 kVA; 5.5% maximum above 112.5 kVA.

.12 Finish: In accordance with Division 26.

.13 Three Phase Windings: arrange with three primary windings connected in delta and three secondary windings connected in wye.

.14 Max. Winding Temperature:

.1 Indoor applications: 150°C rise with temperature continuous full load.

.2 Outdoor applications: 115˚C rise with temperature continuous full load.

.15 Max. Lead Connection: 55°C rise with temperature continuous full load.

.16 Copper winding.

.17 All connections are front accessible only and taps.

2.2 Equipment Identification

.1 Provide equipment identification in accordance with Division 26.

.2 Label size: 7.

2.3 Delivery, Storage, and Handling

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

.2 Requirements:

.1 Store and protect dry type transformers from nicks, scratches, and blemishes.

.2 Replace defective or damaged materials with new.

.3 Provide lifting hooks for complete transformer assembly.

.4 Do not use permanent distribution system dry type transformers for temporary power distribution without permission from the Contract Administrator.

3. EXECUTION

3.1 Installation

.1 Remove shipping supports only after transformer is installed and just before putting into service. Remove shipping bolts, blocking, and wedges.

.2 Coordinate installation of floor, wall-mounted, and structure-hanging supports with actual transformer provided.

.1 Mounting: up to 45 kVA suitable for wall or floor mounting; and above 45 kVA suitable for floor mounting unless otherwise shown.

.1 Brace wall-mounted transformers as specified in Division 26 "Seismic Controls for Electrical Systems."

.2 Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer from design drawings showing acceptable installation location.

.2 Install transformers in level upright position.

.3 Indoor Installation – floor mount:

.1 Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.

.2 Proceed with installation only after unsatisfactory conditions have been corrected.

.3 Ensure adequate clearance around transformer for ventilation.

.4 Construct concrete bases according to Division 3 "Cast-in-Place Concrete" or "Miscellaneous Cast-in-Place Concrete" and anchor floor-mounted transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Division 26 "Hangers and Supports for Electrical Systems."

.5 Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

.6 Secure transformer to concrete base according to manufacturer's written instructions.

.7 Do not install dry type transformers indoors in Category 1 or Category 2 areas.

.8 Examine concrete bases for suitable mounting conditions where transformers will be installed. Install transformers level and plumb on a concrete base with vibration-dampening supports.

.9 Secure transformer to concrete base, rigid, plumb and square according to manufacturer's written instructions.

.4 Loosen isolation pad bolts until no compression is visible.

.5 Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure. Connections to transformers shall be in flexible conduit and shall enter the enclosure below the coils. Make conduit entry into bottom 1/3 of transformer enclosure.

.6 Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

.7 Mount transformers as indicated on Drawings and connect primary, secondary, neutral and ground conductors in accordance with wiring diagrams. Provide brackets and bolts for wall mounted transformers. Ensure all transformers have good ventilation.

.1 Rear Clearance: Provide a minimum of 2-inch (51-mm) clearance from wall, increase with clearance indicated where indicated on nameplate or manufacturers literature.

.2 Ensure adequate clearance around transformers for ventilation and heat radiation.

.8 Mount transformers to reduce direct and transmitted noise. Mount core and coils of transformers on vibration and sound absorbing pads. Install vibration insulators between unit and floor/wall where applicable. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.

.9 Install transformer nameplates with specific transformer data. Provide nameplates and label products.

.10 Verify that ground connections are in place and requirements in Division 26 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

.11 Before energization, keep transformers in electrical room or storage room above 10°C ambient. Energize transformers after installation is complete.

3.2 Grounding

.1 Transformer shall have all noncurrent-carrying metal parts connected to a solid earth grounding system.

3.3 Protection

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by dry type transformers installation.

3.4 Distribution Transformers – Non-Harmonic mitigation Type

.1 Provide primary and secondary voltages, and kVA or MVA capacity as shown on the drawings.

.2 Winding Material: Copper.

.3 Primary Winding: 3-wire delta.

.4 Secondary Winding: Wye

.5 Continuous Duty Overload Capacity: 120% of nominal kVA Rating.

.6 Efficiency: Exceed minimum efficiency requirements for CSA C802.2 and MECB requirements.

.7 Supports NFPA 70E/CSA-Z462 arc flash standard to provide operating data without opening transformer enclosure.

.8 Nameplates: Engraved, laminated-acrylic or melamine plastic signs for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 "Identification for Electrical Systems."

.9 Nameplates: Self-adhesive label for each distribution transformer. Self-adhesive labels are specified in Division 26 "Identification for Electrical Systems."

3.5 Field Quality Control

.1 Perform visual Electrical and Mechanical Inspection.

.2 Report: Prepare a written report recording voltages on the primary and secondary sides, and tap settings. Record and include all tests and their results regardless of type (i.e. include resistances, voltages, current etc.), include equipment used during testing and their calibration data, etc. All test sheets shall signed and provided to the Contract administrator for review.

.3 Vacuum dirt and debris; do not use compressed air to assist in cleaning.

.1 Electrical Tests:

.1 Measure resistance at each winding, tap, and bolted connection.

.2 Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5.

.3 Record secondary voltage when transformers are carrying approximately 75% of full load. Adjust tap connections to give a continuous secondary voltage of 120 V phase to neutral. Set tap connections for above 120 V rather than below.

3.6 Acceptable Manufacturers

.1 The manufacturers listed can provide dry type transformers, but only a few of the listed manufacturers have full capability to provide harmonic and specialty type transformers. It is the contractors responsibility to coordinate the application specific requirements with the appropriate manufacturer where required.

.2 Marcus Transformer.

.3 Powersmiths International Corp.

.4 Hammond Manufacturing Co. Inc.

.5 Eaton.

.6 Schneider Electric.

.7 Or approved equal.

3.7 Closeout Activities

.1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Provide operation and maintenance data for incorporation into manual specified in Division 1.

.3 Include insulating liquid maintenance data.

END OF SECTION

1. GENERAL

1.1 Related Sections

.1 This Section provides comprehensive requirements for the design, installation, and other application specific requirements for Pad-mounted Medium Voltage (MV) Transformers.

.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section. This section supplements requirements of other Divisions.

1.2 Description

.1 This section covers the furnishing of all materials, equipment and services for the design, fabrication, supply and delivery, installation/labour, and testing of outdoor pad-mounted transformers.

.2 This specification outlines only general performance and minimum requirements; it is not intended to relieve the Vendor of responsibility for the design of equipment in accordance with the latest applicable codes and standards.

.3 The intent of this specification is to convey minimum requirements for complete, operable, safe, effective and approved equipment delivered to the site ready for installation.

1.3 References

.1 ASTM International (ASTM):

.1 B117, Standard Practise for Operating Salt Spray (Fog) Apparatus.

.2 D117, Standard Guide for Sampling, Test Methods, and Specifications for Electrical Insulating Oils of Petroleum Origin.

.3 D4059, Standard Test Method for Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography (PCB).

.4 36, Standard Specification for Structural Steel.

.2 Canadian Standards Association (CSA):

.1 C2.1, Single-Phase and Three-Phase Liquid-Filled Distribution Transformers.

.2 CAN3-C235, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

.3 C22.1, Canadian Electrical Code Part I (CEC) as amended by provincial, territorial or municipal authority having jurisdiction. References to CEC elsewhere in this document shall include reference to such amendments.

.4 C22.2 No. 0, General Requirements – Canadian Electrical Code – Part II.

.5 C22.2 No. 295, Neutral grounding devices.

.6 C22.3 No. 1, Overhead Systems.

.7 C22.3 No.7, Underground Systems.

.8 C88, Power Transformers and Reactors.

.9 C227.3, Low-Profile, Single-Phase, Dead Front, Pad-Mounted Distribution Transformers.

.10 C227.4: Three-Phase, Dead Front Pad-Mounted Distribution Transformers with Separable Insulated High-Voltage Connectors.

.11 C802.1, Minimum Efficiency Values for Liquid-Filled Distribution Transformers.

.12 C802.3, Minimum efficiency values for Power Transformers.

.3 Electrical and Electronic Manufacturers' Association of Canada (EEMAC), now known as Electro-Federation Canada.

.4 International Electrotechnical Commission (IEC):

.1 60076-8, Power Transformers – Application Guide.

.2 60214-2, Standard for Tap-changers.

.5 Institute of Electrical and Electronics Engineers (IEEE):

.1 386, Standard for Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5kV through 35kV.

.2 C57.12.00, Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.

.3 C57.12.26, Standard for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers for Use with Separable Insulated High-Voltage Connectors (34 500 Grd Y/19 920 V and Below; 2500 kVA and Smaller).

.4 C57.12.00, Standard for General Requirements for Liquid-Immersed Distribution, Power and Regulating Transformers.

.5 C57.12.10, Standard Requirements for Liquid-Immersed Power Transformers.

.6 C57.12.28, Standard for Pad-Mounted Equipment - Enclosure Integrity.

.7 C57.12.34, Standard Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers, 10 MVA and Smaller; High-Voltage, 34.5 kV Nominal System Voltage and Below; Low-Voltage, 15kV Nominal System Voltage and Below.

.8 C57.12.70, Standard for Standard Terminal markings and Connections for Distribution and Power transformers.

.9 C57.12.90, Test Code for Liquid-Immersed Distribution, Power, And Regulating Transformers.

.10 C57.32, Standard for Requirements, Terminology, and Test Procedures for Neutral Grounding Devices.

.11 C57.91, Guide for Loading Mineral-Oil-Immersed Transformers and Step-Voltage Regulators.

.12 C57.98, Guide for transformer impulse tests.

.13 C57.109, Guide for liquid immersed transformer through-fault current duration.

.14 C57.131, Standard Requirements for Tap Changers.

.15 C57.153, Guide for Paralleling Regulating Transformers.

.6 Manitoba Workplace Safety and Health Act, and Regulations.

.7 Manitoba Energy Code for Buildings (MECB):

.1 Manitoba amendments to the National Energy Code of Canada for Buildings.

.8 National Electrical Manufacturers Association (NEMA):

.1 TRI, Transformers, Regulators and Reactors.

.9 National Electrical Testing Association (NETA):

.1 ATS – Acceptance Testing Specifications for Electrical Power Equipment and Systems.

.10 Winnipeg Electrical By-law (WEB):

.1 Winnipeg amendments to the Canadian Electrical Code (CEC).

.11 Winnipeg Building By-law (WBB):

.1 Winnipeg amendments to the National Building Code of Canada (NBC).

1.4 Design Requirements

.1 The Transformer shall be designed and manufactured in accordance with the Vendor's standard and shall meet the applicable industrial standards. All transformers shall be by the same equipment vendor – no split packages are allowed.

.2 Downstream Loads:

.1 The transformers have variable frequency drives connected to them and should be designed to account for VFD loads. The minimum harmonic K-factor shall be K4, or higher when indicated on the drawings.

.2 The transformers have welders connected to them and should be designed for to account for this load type. The largest welder has a rated power of 44 kVA with 50% operating factor at 600 VAC, 3 phases.

.3 For non-drive system motors, at 600 VAC, 3 phases the smallest motors shall be 0.75 HP, and the largest shall be 150HP.

.3 The Transformer shall be designed for outdoor use and for continuous operation, twenty-four (24) hours per day, 365 days per year.

.4 The Transformer shall be an oil filled type, pad mounted, complete with cable compartments, options and accessories to form complete factory assembled, self contained, steel fabricated unit for mounting on a concrete pad.

.1 Type: KNAN (Oil with flash point greater then 300˚C, oil natural, air natural), with provision for future fans (KNAF):

.1 Provision for future cooling equipment shall mean that all necessary terminal blocks, control panels, and fan wiring will be supplied at the time of transformer purchase. The only equipment accessories required at a later date will be the fans and their mounting brackets.

.2 The provision shall assume one external 208V three-phase 60 Hz power supply to the control cabinet of the transformer. The supply will be used to operate cooling fans (when provided), auxiliary 208-120V control transformer, and controls section heater (if required).

.3 Oil type: Ester Dielectric (Environtemp FR3), PCB free, suitable for artic conditions.

.5 Refer to other Transformer requirements as provided further in this specification and in the drawings.

1.5 Warranty

.1 As a minimum, the Vendor shall include a warranty for twelve (12) months of operation or eighteen (18) months after arrival on Site, whichever is less. The Vendor shall state their standard warranty for the Transformer specified.

.2 Vendor shall extend the warranty to three (3) years.

1.6 Submittals

.1 Provide submittals in accordance with Division 1 and Division 26.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, and limitations.

.2 Submit catalogue cuts for transformer pads.

.3 Submit Shop Drawings giving equipment dimensions, anchoring information, total weight, ratings of the transformer, switches, fuses, and breakers. Provide data on pressure-relief valves, oil sampling valves (drain, tap, sample), pressure/vacuum gauge, pressure/vacuum regulation, level gauge, liquid temperature indicator, and separable connectors. Shop drawings shall also indicate:

.1 Anchoring method and dimensioned foundation template.

.2 Dimensioned cable entry locations.

.3 Dimensioned cable termination and pothead height.

.4 General arrangement drawings and outline dimensions.

.5 Electrical and instrumentation diagrams.

.6 Complete bill of materials listing the scope of supply.

.7 Identified internal and external component layout on assembly drawing.

.8 Primary and secondary fuse make, model, size and time-current characteristics.

.9 Insulating liquid capacity.

.10 Insulating liquid materials.

.4 Provide recommended spare parts and prices

.5 Provide estimated losses at no load, 50% load and full load in either Watts per hour (preferred), or BTUs per hour.

.6 Include Quality Assurance Submittals:

.1 Manufacturing and quality assurance procedures.

.2 Engineering, manufacturing and quality assurance milestone schedule.

.3 Factory Tests: Furnish manufacturer's certified standard test reports for the transformer ratings shown in the drawings and for the tests specified herein.

.4 Instruction Manuals: Furnish manufacturer's installation and maintenance manuals on the transformers and accessories.

.7 Closeout Submittals:

.1 Provide operation and maintenance data for pad mounted distribution transformers for incorporation into manual specified in Division 1.

.2 Include insulating liquid maintenance data.

.3 Submit to the Contract Administrator standard factory test certificates of each transformer and type test of each transformer with high voltage accessories in accordance with CSA,

manufacturer standard tests, and onsite testing/commission in accordance with Division 26. Include test results and documents in the O&M Manuals.

1.7 Quality Assurance

.1 Manufacturer Qualifications: Single source manufacturer regularly engaged in manufacturing pad-mounted transformers complying with requirements of these Specifications and experienced with at least 5 projects of similar size and scope.

.2 Product Selection for Restricted Space: Drawings indicate size, profiles, and dimensions for pad-mounted transformer equipment including clearances between pad-mounted transformers and adjacent surfaces and items, and are based on manufacturer's preliminary information.

.3 Regulatory Requirements:

.1 Components and installation shall comply with CSA.

.4 IEEE Compliance: Comply with applicable requirements of IEEE standards, including IEEE C2.1.

1.8 Sequencing and Scheduling

.1 It is the responsibility of the electrical contractor to coordinate the size/compartment/ locations on the approved Shop Drawings prior to installing duct work, cable bus, conduits and cables.

.2 Coordinate size and location of concrete bases and pads. Cast anchor bolt inserts into pad.

.3 Coordinate size and location of the fence/bollards surrounding the transformer installation.

1.9 Delivery, Storage and Handling

.1 Coordinate delivery of pad-mounted transformers in shipping splits to allow movement into designated space.

.2 Handle pad-mounted transformers components in accordance with manufacturer's instructions. Use factory installed lifting provisions (minimum of 4 lifting lugs).

.3 All radiator valves are to be properly gasketed and sealed off prior to shipment to ensure no loss of oil or moisture infiltration.

.4 Radiators are to be removed from transformer, properly packaged, sealed from atmospheric elements and shipped separately from the transformer.

.5 One (1) set of gaskets/o-rings shall be supplied with the transformer to replace bushing and radiator shipping seals.

.6 Transformer is to be shipped via an air-ride trailer. A suitable impact recorder that measures impacts in the X, Y and Z direction is to be installed on the transformer prior to shipping. This impact recorder is to be inspected prior to offloading of the transformer at its final destination.

.7 Complete installation instructions for any parts shipped separate from transformers shall accompany transformer shipment.

.8 Material safety data sheet(s) (MSDS's) for equipment shall be provided to shipper at time of shipping.

.1 MSDS's shall conform to all relevant regulations where equipment will be located.

.2 If any chemical so shipped is exempt from such laws, a statement to that effect shall be included on MSDS.

.3 MSDS's shall be provided to the City a minimum of two (2) weeks before shipment to allow for entrance to customer site.

.4 Oil shall be non-PCB.

1.10 Maintenance

.1 Provide maintenance materials for incorporation into O&M manuals in accordance with Division 1.

.2 Extra Materials:

.1 Furnish extra materials matching products installed as described below, packaged with protective covering for storage, and identified with labels clearly describing contents.

.2 Touch-Up Paint: 3 half-pint (240 mL) containers of paint matching enclosure exterior finish.

.3 Contact Lubricant: 1 container.

2. PRODUCTS

2.1 Acceptable Manufacturers

.1 Pioneer Transformer.

.2 Hammond Power.

.3 Partner Technologies Incorporated (PTI).

.4 Schneider.

.5 ABB.

.6 Eaton (Cooper Power Systems).

.7 Stein Industries Inc.

.8 Carte International.

.9 Village Enterprises Ltd. (VEL).

.10 Delta Star Inc.

2.2 Transformer Rating Characteristics

.1 The provided Ratings called out here are specific to the project or application, ratings not specifically called out here need to conform to industry recognized and standard specific requirements. Refer to other parts of this specification for additional requirements.

.2 Primary voltage: 4160 V connected, delta.

.3 Secondary voltage: 600 V connected, wye.

.1 X0 shall be connected to the NGR by two separate conductors.

.2 The transformer design shall be capable of operating above rated voltage or below rated frequency in accordance with CSA C88.

.3 NGR shall be 69.4 Ohms +/- 10%, 5A continuous rated, for a system voltage of 600 V, and Line-to-Neutral of 347V.

.4 Capacity: 1.5 MVA.

.5 Primary Side Basic impulse level (BIL): 75 kV:

.1 Transformers of 5 kV, 15 kV, 27 kV or 35 kV class shall have impulse insulation levels of 75 kV, 95 kV, 150 kV or 200 kV respectively unless otherwise stated in the supplementary specification. The corresponding low frequency test levels shall be as per CSA Standard CSA C88.

.2 kV Class: 15 kV.

.6 Secondary Size Basic impulse level (BIL): 30 kV (minimum):

.1 kV Class: 1.2 kV.

.7 Bushings:

.1 The type and design of the bushing is coordinated with the impulse level of the transformer to form an integrated insulation system. Transformers shall be shipped with the bushings mounted in place.

.8 The transformer shall be designed and constructed to be completely self-protected by its ability to withstand the external short-circuits, as defined and tested in accordance with CSA C88.

.1 Maximum rms short-circuit: 25 kA, on the primary side.

.2 Transformer shall withstand thermally and mechanically two second (or greater) short circuit at its secondary terminals.

.9 Minimum %Z Impedance:

.1 The minimum impedance (%Z) shall be based on the self-cooled rating of the transformer. The typical desired %Z has been provided below, and not more then 1.5% above minimum levels.

kVA	% Z
150 and smaller	2.0
225	3.5
300	4.0
500	4.0
750 and larger	5.75

.10 Losses:

.1 The no-load loss and exciting current for an individual three-phase transformer shall not exceed the guaranteed value by more than 7.5%.

2.3 Transformer Manufacture

.1 Transformer: Unit shall be dead front, 3-phase, two winding, 60 Hertz, 65°C (117°F) rise above a 40°C (104°F) ambient, self-cooled, the windings shall be copper.

.1 The high potential (HP) winding of a three-phase transformer shall be delta-connected and the low potential (LP) winding shall be wye-connected with angular displacement of 30 degrees (X lagging H) in accordance with CSA Standard CSA C88.

.2 Core: Cold rolled grain-oriented steel lamination.

.2 Grounding:

.1 Tinned Copper grounding bus sized for the transformation, mounted on insulators rated for the system voltages. Separate Ground bus in HV & LV compartments.

.2 Provisions for connection for a minimum of six (6) ground cables to accommodate cable sizes as per the Drawings. Provisions shall be provided for additional 20% grounding connections.

.3 2-hole long barrel copper crimp connector type.

.4 Transformer shall be provided with stainless steel grounding pads at two diagonally opposite ends.

.3 Complete with primary and secondary cable termination enclosures. The cabinets shall be stainless steel and constructed in such a manner as to prevent corrosion, and to allow bottom entry and allow sufficient room for stress cone application.

.1 Primary Compartment: Provide the following equipment as a minimum:

.1 Dead-front construction.

.2 Radial construction.

.3 Fused disconnecting switch.

.1 Single source primary feed.

.2 Draw-out dry well mounted current-limiting fuses. Loose supply one spare complete set of fuses for the client (minimum 3 fuses).

.3 Bay-O-Net style fuse may only be used in two-fuse protection schemes where a current-limit backup/main fuse is utilized. The high-level faults are cleared by the current-limiting backup/main fuse, whilst the secondary faults and overload currents are cleared by the Bay-O-Net fuse for internal equipment protection.

.4 Bushings: Separable insulated (dead front) connectors for power distribution systems above 600 V shall conform to IEEE 386. Bushing well connectors with bushing well inserts to shall also conform to IEEE 386.

.1 Medium-voltage bushing inserts and bushings for separable loadbreak elbow connectors, amperes continuous. Provide a parking stand for each elbow connector. Equip connector with steel-reinforced hook-stick eye, grounding eye, test point, and arc-quenching material.

.2 Shall be suitable for termination of conductors as indicated on the Drawings.

.5 Surge Protection Device (SPD) with 3-phase fuse box for primary side protection.

.1 Manufacturer: Magney Grande p/n MGFMV-40SB, or approved equal.

.6 Mechanical interlock to prevent access to primary compartment unless primary supply is isolated at source. Separate padlocking for primary compartment door.

.7 Tap Changer:

.1 External tap changing handle operable only when the transformer is de-energized.

.2 Fitted with a manually operated de-energized off-load-tap-changer on the primary winding, with four (4) taps at 2.5%, two (2) FCAN and two (2) FCBN, externally operated and equipped with a pad-lockable handle capable of pad-locking in each tap position.

.3 The tap changer shall be capable of carrying the full transformer short-circuit current without damage or contact separation.

.4 The tap changer shall be gang operated from a single operating point and shall have an easily visible position indicator.

.5 Tap changer shall be functional at minus (-) 40˚C ambient.

.4 Low-Voltage Compartment: Provide the following equipment as a minimum:

.1 Dead-front construction.

.2 Secondary low-voltage bushings with spade terminals designed for copper conductors. All customer connections shall be wired to terminal blocks and be clearly identified on the wiring diagrams.

.1 Minimum of NEMA 8-hole pad (copper) voltage terminals, suitable for a minimum of six (6) conductors per phase, size (6) conductors per neutral. Refer to the single line drawing for required cable connections.

.2 Low-voltage bushings shall be separable insulated connectors.

.3 All transformers sized greater than 1000 kVA shall have an insulated neutral X0 bushing with a removable ground strap accessible from the cable compartment to incorporate NGR installation where required. X0 should not be connected to ground that is internal to the oil-filled transformer compartment.

.1 The wye point of the Low Potential (LP) winding shall be brought to a bushing for the connection of an external high resistance ground (HRG) located on top of the transformer enclosure. This bushing should be located near the top of the compartment so as to easily connect to the neutral ground resistor (NGR).

.2 X0 shall be connected to the NGR by two separate conductors.

.3 The entire resistor assembly shall be mounted on insulators rated for the system voltage.

.4 Resistor elements shall be modular in design so that replacement is easy.

.5 The NGR shall be continuously monitored to ensure that the grounding circuit has not opened.

.6 The monitoring system shall include the Zener diode, Current Transformer (C.T.) monitoring resistor, and Bender relay (NGRM700 Series). The relay shall be mounted in the transformer control cabinet, and the output of the relay shall be wired to terminal blocks within the Low Voltage Cabinet. The NGR control box shall be mounted to the side of the Low Voltage Cabinet.

.7 Loose supply portable ground fault detector kit for use with the Bender pulse down function option.

.8 The monitoring system shall be complete with all wiring.

.9 The NGR will be rated for outdoor use and temperatures between -40°C and +40°C

.3 Liquid level gauge, dial type.

.4 Thermometer, dial type.

.5 Oil filling connection.

.6 Drainage, equalization, and oil sample valves.

.7 Transformer case grounding pad.

.8 Circuit breaker or fused disconnect switches for control circuits.

.1 Should breakers be utilized, loose supply one spare to be left inside this cabinet.

.2 Should fuses be utilized, loose supply 3 spare for each fuse size to be left inside this cabinet.

.9 Insulating Fluid and Preservation System:

.1 The fluid preservation system shall be a sealed tank type.

.2 The insulating fluid shall be silicone fluid, known chemically as Poly Dimethyl Siloxane (PDMS) fluid.

.3 The transformer insulating fluid shall meet or exceed the requirements of the appropriate ANSI and ASTM fluid Standards. The transformer fluid shall be tested for dielectric breakdown and moisture content just prior to the time of shipment.

.4 The gaskets shall be compatible for the insulating fluid in the transformer tank. Metal surfaces to which gaskets are applied shall be smooth, and shall have sufficient rigidity to assure proper compression of the gaskets.

.5 Compliance:

.1 Transformer shall comply with the Energy Efficiency Standards for Distribution Transformers and CSA C802.1.

.2 The transformer shall be designed to meet the average sound-level specified in CSA C88 Table 8, and CSA C227.4 Table 5, in general dBA of approximately:

.1 Less then 750 kVA: 56 dBA.

.2 750 kVA through to 1000 kVA: 58 dBA.

.3 2500 kVA and above: 62 dBA.

.3 All steel welding shall conform to the requirements of CSA W59.

.6 The transformer shall include additional accessories to form a complete factory assembled, self contained, steel fabricated unit for mounting on a concrete pad.

.1 Liquid temperature thermometer (x3), each status with two (2) sets of dry contacts. Provides status for Fan Operation, Alarm status, and Trip status.

.2 Winding Temperature Indicator and dry contacts. Temperature probe to be located in the centre winding.

.3 Liquid level gauge with two (2) sets of dry contacts. Provides Low level alarm status.

.4 Vacuum / Pressure gauge with two (2) sets of dry contacts.

.5 Pressure relief device with two (2) sets of dry contacts.

.6 Filler plug.

.7 Enclosures:

.1 All enclosures and sub-assemblies shall be weather-resistant for outdoor Canadian weather (-40C to +40C temperature swing), with lockable provisions, and tamper-proof. Isolate and interlock high- and low-voltage enclosure compartments, with separate hinged doors.

.2 Kirk Key Interlock between transformer door and upstream feeder breaker. Key is to be released via the upstream breaker rack-out mechanism.

.3 The minimum enclosure environmental ratings of CSA/NEMA/EEMAC 4.

.4 Enclosure base shall have a 4 mil (0.1 mm) thick tar-mastic undercoat.

.5 Doors shall be provided with pad-lockable three-point latch with penta-head bolts and shall include door stays to hold compartment doors in the 110˚ open position.

.6 Box type stiffeners shall be provided with drains to prevent accumulation of water or leaked insulating liquid.

.7 The transformer shall be fitted with four jacking steps, each capable of supporting one half the weight of the transformer when filled with oil. Each step shall have a minimum free surface area for the head of the jack of 160 mm x 200 mm. The distance from the base to the jacking points shall be at least 300 mm.

.8 Hauling eyes, or 50 mm diameter holes, shall be provided at the transformer base, in pairs, to permit the transformer to be moved in either direction along the major axis or the minor axis. Both eyes or holes of each pair shall be approximately equidistant from the center of gravity of the complete transformer.

.8 Equipment Identification, Signs, and Warnings

.1 Provide equipment identification in accordance with Division 26.

.2 Install "DANGER--HIGH VOLTAGE--KEEP OUT" signs with tamper-proof stainless steel screws on each accessible side of pad-mounted transformers.

.3 Provide a warning nameplate located near the sampling valve “WARNING – EQUALIZE INTERNAL PRESSURE PRIOR TO TAKING SAMPLES”.

.4 Corrosion-resistant nameplate and connection diagram except that the number of gallons (litres) of coolant shall be shown.

.5 Provide additional labeling as required by the authority having jurisdiction (AHJ).

.9 Manufacturer Rating Plates:

.1 Provide metallic (stainless steel) CSA label on the outside of the transformer and on the inside of the transformer in the cable compartment.

.2 Transformer shall be furnished with a non-corrosive diagrammatic nameplate, permanently attached with non-corrosive hardware. The diagrammatic nameplate shall include the name of the manufacturer of the equipment as well as the location where the transformer was manufactured and tested.

.3 In addition to the main rating plate, plates with identification and characteristics of auxiliary equipment (bushings, tap changers, special cooling equipment etc.)

.4 The Load Tap Changer (LTC) shall also contain a tap changer nameplate, permanently attached to the LTC compartment.

.1 Includes impedances on extreme tap positions.

.2 Serial number, make and complete type designation of tap changers.

.3 A non-corrosive nameplate located next to the operating handle of the de-energized tap changer shall be provided which states the following: ‘Danger - Do not operate tap changer when the transformer is energized.”

.5 Includes notation of all standards used in its manufacturer, and the manufactured date.

.6 Non-linear devices, capacitors, resistors etc. as installed on the on the winding assembly or on any tap changer shall be indicated on the nameplate.

.7 The nameplate shall contain all connection and rating information in accordance with CSA C88 and CSA C227.4 including but not limited to the following:

.1 Phasor diagram for polyphase transformers including hour clock designation (Dyn11, Dyn1 etc.)

.2 MVA rating of the Transformer shall include existing and future MVA by cooling class. Provision for future includes Forced-cooling equipment.

.3 Voltage transformers, potential devices, current transformers, winding temperature, and other misc. devices when used shall be shown.

.4 All internal leads and terminals not permanently connected shall be identified with numbers or letters in a manner that permits convenient reference to prevent confusion with terminal and polarity markings.

.5 Contains no detectable level of PCB (less than 1 ppm) at the time of manufacture.

.6 Vacuum withstand capability of conservator and all oil circulating parts as appliable.

.7 Diagram showing the location of major valves (drain, filter etc.)

.8 Type of Oil.

.9 Sound Levels at all ratings (sound pressure or intensity).

.10 PCB content in oil (less than 1 ppm) at the time of first filling.

.8 Where applicable also show the following:

.1 Tie-in resistor including their rating and the manufacturer's name.

.2 Type, make, and serial number of the LTC reactors.

.3 Current limiting reactors including their impedance values and the manufacturer's name.

.4 On nitrogen pressurized transformers minimum and maximum pressure setting of the regulator.

.5 Location of static cylinders when used (on the core, under LTC windings etc.)

.6 A statement that the voltages and currents marked are based on no-load and are not during the load.

.7 Zero sequence impedance.

.8 Make, serial number, voltage ratio and rating of series transformer and/or compensating transformer when used.

.9 Construction designation – core type or shell type. Core details – single, two, three, four, five or seven legged.

.10 Maximum current in common winding on autotransformers with loading and during the step-up operation.

.9 Rating plate shall indicate the transformer was built to CSA C2.1, is energy efficient per CSA-C802.1, and show markings suitable for use in Canada.

2.4 Factory Finish

.1 Provide with a factory-applied, corrosion-resistant finish which shall withstand 3,000 hours of exposure to the salt spray test specified in ASTM B117 without loss of paint or release of adhesion of paint primer coat to the metal surface in excess of 1/16 inch from the scribed test mark.

.2 Cut edges or otherwise damaged surfaces of galvanized steel shall be coated with a zinc-rich paint.

.3 Exterior Finish: Munsell 7GY3.29/1.5 Green.

2.5 Factory Test

.1 In addition to the production tests specified by CSA C88, perform the following factory tests:

.1 Test methods shall be in accordance with IEEE C57.12.90, and IEEE C57.12.00 Section 8.1.

.1 An impulse test shall be carried out on each terminal of every transformer. The tests shall be based on 100% of BIL and shall be carried out in the sequence given in CSA C88. Low potential windings rated less than 1.5 KV class need not be impulse tested.

.1 ANSI reduced full wave, chopped wave impulse test with oscillograph record.

.2 ANSI full wave impulse test, observed by oscilloscope.

.2 Load loss and impedance shall be measured at full load for every transformer.

.3 The core insulation shall be tested at 5000 V. The minimum insulation resistance shall be 100 M-ohms in each of the following tests:

.1 Before final assembly of coils, for each core or core section to:

.1 All others core sections.

.2 Each core bolt and ground.

.3 Ground.

.4 Perform the following tests/checks in accordance with CSA C2:

.1 Leak detection test at 50kPA for a 24 hour period

.2 Ratio test on all tap connections within 0.5% tolerance

.3 Polarity Tested: Three phase, Angular displacement

.4 Operation tests on all devices

.5 Applied Voltage (60Hz):

.1 HV to LV and Grd at 19kV for 1 minute.

.2 LV to HV and Grd at 10kV for 1 minute.

.6 Induce Potential at: 2 times 647V at 400 Hz for 18 seconds.

.5 Partial discharges shall be measured on one transformer of each type during the induced potential test.

.6 Complete ANSI temperature tests.

.7 A certified test report shall be submitted and shall contain the test data for each transformer serial number manufactured. The certified test report shall as a minimum contain the data as specified in ANSI C57.12.90.

.2 Transformer shall comply to CSA C2.1 and come factory certified with markings suitable for use in Canada. Factory install external CSA transformer nameplates, stainless steel, engraved. Affixed using rivets.

2.6 Equipment Identification

.1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Provide metallic (stainless steel) CSA label on the outside of the transformer and on the inside of the transformer in the cable compartment.

.3 Provide size 11, hard plastic equipment identification lamacoid on the outside of the transformer, example as follows:

XFMR-Y701 10 000 kVA, 66 kV – 12.47 kV, 3Ø, 4W FED FROM CS-Y701

2.7 Warning Signs

.1 Provide warning signs in accordance with Section 26 05 01, Common Work Results - Electrical and in accordance with the requirements of the CEC.

.2 Provide high voltage warning signs in accordance with AHJ requirements.

3. EXECUTION

3.1 Transformer Pads

.1 Coordinate with the manufacturer and other divisions as required.

.2 Provide precast concrete transformer pads sized per transformer manufacturer requirements. Provide reinforcement for parkway (nontraffic) loading. Concrete pad requirements should be coordinated with Manufacturer.

.3 When indicated on the drawings, or called out by the design, provide precast concrete slab box, consisting of transformer pad and precast concrete box below. Box shall have reinforcement for H-20 traffic bridge loading. Provide hot-dipped galvanized steel parkway covers for access openings.

3.2 Installation

.1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

.2 Location of underground structures and field conditions is the responsibility of the contractor. The contractor shall investigate/coordinate existence and location of all services before proceeding with the construction.

.1 Provide soft digging around existing services. Expose all communication, power ducts and lines by Hydrovac excavation.

.2 The contractor is responsible for all damaged cables and services. All cables shall be suitable for direct burial.

.3 Provide temporary sheeting, piling or shoring as required to protect excavations and trenches from damage caused by rain water, groundwater and other soil and weather conditions. Erect in a manner which will not encumber the performance of the work.

.4 Transformer Concrete Slab

.1 Conduit sleeves (for grounding, power, controls etc.) shall be full height of slab thickness and extend above slab a minimum of 50 mm. Minimum conduit depth beneath the slab is 0.86 m to allow for long sweep elbows, and shall extend a minimum 0.3 m beyond the slab.

.2 Install pad-mounted transformer in conformance to the manufacturer's mounting instructions including securing it to the concrete slab by a minimum of four anchor bolts.

.3 Provide a minimum of four grout pads under each corner of the transformer to level the unit. Provide details of anchor bolts for transformer to slab connection. The anchor bolt connections need to provide minimum depth into concrete in consideration of the height of the grout pads. Grout pads shall raise the transformer a minimum of 75 mm above the slab.

.4 Concrete slab shall be a minimum Type 4 concrete with clear concrete cover to reinforcing steel. Reinforcing steel shall be a minimum 75 mm for bottom, 50 mm for all other surfaces, 15 m @ 300 E.F./E.W. Typ. Slab shall extend a minimum 1 m around the transformer, and shall maintain a 2% slope on all sides. Slab shall sit on Grannular fill of 20 mm down Typical. Provide slab and all appurtenances for the Contract Administrator’s review.

.5 Ensure concrete pad is fully cured before transformer is installed and in accordance with local codes/standards, manufacturers requirements, and the contract documents.

.6 Regrade area and lower berm to suit Transformer pad.

.5 Set and secure transformer unit in place, rigid, plumb and square.

.6 Make grounding/bonding, power, and control connections.

.7 Provide control power, 208V, 3PH from an appropriate panelboard on site. Provide appropriate breaker size, and update the panelboard schedule accordingly.

.8 Connect transformer unit ground bus to system ground (as applicable).

.9 Install neutral grounding resistor and make connections (as applicable). Check for grounding and neutral continuity between primary and secondary circuits of transformer (where applicable). Check for isolation between X0 and ground bus where NGRs are installed.

.1 If no NGR is required confirm and make connection between X0 and ground and check for continuity.

.10 Provide wiring to the facility PLC system for status.

.1 Provide Alarm or statuses for Liquid Level Alarm, Fan operation, Liquid Temperature Alarm, Pressure relief Alarm, NGR status/Alarm, and SPD Alarm. Refer to the loop wiring diagrams and drawings for additional requirements.

.11 Ensure care is taken to prevent contamination of liquid and components when field filling the transformers. Use only metal hose when field-filling transformer with oil: do not use rubber hose.

.12 Set taps to produce rated secondary voltage at no-load.

3.3 Grounding

.1 Pad-mounted transformer shall have all noncurrent-carrying metal parts connected to a solid earth ground electrode.

.2 The transformer shall be supplied with two diagonally opposite stainless steel ground pads, one of which shall be fitted with a connector suitable for securely clamping 4/0 AWG copper cable.

.3 The transformer shall be equipped with four (4) grounding ball studs c/w covers. One ball stud shall be installed on the base exterior directly bolted to transformer ground bus. In addition, one ball stud shall be bolted to each secondary phase bushings/bus.

.4 Provide Bonding of the fencing/bollards surrounding the transformer installation.

3.4 Field Tests and Quality Control

.1 Perform tests in accordance with Division 26.

.2 Check factory made connections of transformer unit for mechanical security and electrical continuity.

.3 Check transformer insulating liquid for correct quantity/level and specification according to manufacturer's instructions.

.1 Check oil level and temperature indicators.

.2 Inspect for oil leaks and excessive rusting.

.4 Confirm that the neutral X0 terminal is insulated and not internally grounded.

.5 Perform field tests in accordance with NETA ATS Part 7.2.2.

.1 Carry out following insulation tests using megger with 20,000 megohm scale and resulting insulation resistance corrected to base of 20°C.

.1 High voltage to ground with secondary grounded for duration of test.

.2 Low voltage to ground with primary grounded for duration of test.

.3 High to low voltage.

.2 Complete turn to turn ration tests for all tap changer positions.

.3 Inspect primary and secondary connections for tightness and for signs of overheating.

.4 Inspect and clean bushings and insulators.

.6 Check fuses for correctness of type and size.

.7 Check for grounding and neutral continuity between primary and secondary circuits of transformer.

.8 Set transformer taps to rated voltage as specified.

.1 Adjusting: Adjust primary taps so secondary voltage is above, and within 2% of rated voltage.

.9 After the installation has been completed, conduct an operating test demonstrating that all equipment devices operate in accordance with the requirements of the drawings and specifications.

.10 Operating Test: Energize the transformer and adjust the output voltage to the specified value. Further readjust tap settings, if necessary, after the facility being served is in normal operation.

.11 Have transformer oil sample taken once transformer has been energized and conduct Oil and Gas analysis on sample.

.12 Have a second sample taken after three months operation and conduct Oil and Gas analysis on sample. Test facility will produce a report comparing the results of both tests.

.13 Submit to the Contract Administrator the standard factory test certificates of each transformer and type test of each transformer with high voltage accessories in accordance with CSA C2.

.14 Prior to end of Transformer warranty period the contractor will again take an oil sample and conduct Oil and Gas analysis on sample. Test facility will produce a report comparing the results of all three tests.

3.5 Closeout Activities

.1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Provide operation and maintenance data for pad mounted distribution transformers for incorporation into manual specified in Division 1.

.3 Include insulating liquid maintenance data.

END OF SECTION

PANELBOARDS – BREAKER TYPE

1. GENERAL

1.1 Related Sections

.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section. This section supplements requirements of other Divisions.

.1 Section includes various equipment and testing requirements that may be required for the project and the applications where each type shall be used.

1.2 References

.1 Canadian Standards Association (CSA):

.1 CSA C22.1, Canadian Electrical Code Part I (CEC) as amended by provincial, territorial or municipal authority having jurisdiction. References to CEC/MEC elsewhere in this document shall include reference to such amendments.

.2 C22.2 No.29, Panelboards and Enclosed Panelboards.

1.3 Action and Informational Submittals

.1 Submit in accordance with Division 1.

.2 Product Data and Literature:

.1 Submit manufacturer's instructions, printed product literature and data sheets for panelboards and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Include on drawings:

.1 Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

.2 Ensure specialty breaker types are identified for branch circuits where Ground Fault Circuit Interrupter (GFCI) capacity, or Arc Fault Circuit Interrupter (AFCI) capacity are required.

2. PRODUCTS

2.1 Panelboards

.1 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.

.2 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

.3 Product of one Manufacturer.

.1 Install circuit breakers in panelboards before shipment.

.2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

.4 Panelboard Ratings:

.1 CSA or cUL approved short circuit current rating (SCCR) to meet the minimum rating as shown on the drawings.

.2 If minimum SCCR is not shown on the drawing for panelboards up to 240 volts provide 25,000 RMS symmetrical amp minimum bracing.

.3 If the minimum SCCR is not shown on the drawings for panelboards up to 600V provide 50,000 RMS symmetrical amp minimum bracing.

.4 Series rated breakers not acceptable.

.5 Bussing:

.1 Distributed phase sequence type.

.2 Tin plated copper bus with neutral of same ampere rating of mains.

.3 Behind usable space, with mounting hardware.

.4 Isolated ground bus, with minimum three (3) terminals for bonding conductors equal to breaker capacity of the panelboard.

.5 Mains: suitable for bolt-on breakers (Anti-turn solderless type).

.6 Main breaker or main lugs only, as detailed on Drawings.

.7 Surge Protection Device (SPD), Type 2, with rated isolation breaker.

.6 Enclosure Construction:

.1 Gutters adequate for wire size used, 4 inch (100 mm) minimum.

.1 Code gauge galvanized steel, without knockouts.

.2 Dead front safety type, lockable, with two (2) keys for each panelboard all keyed alike.

.3 Flush stainless steel cylinder tumbler type locks (rain and ice resistant) with spring loaded door pulls.

.4 Trim and door finish: Rust inhibiting primer, baked enamel finish.

.5 Trim with concealed front bolts and hinges.

.6 Enclosure to be 508 mm wide minimum.

2.2 Breakers

.1 Breakers: to Division 26 “Moulded Case Circuit Breakers”.

.2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

.3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

.4 Lock-out Tag-out (LOTO): Provide Spare Lock-on device for one 1P and one 3P breakers. Turn over unused lock-on devices to City.

.5 Provide Lock-on devices for

.1 Fire alarm circuit (paint this circuit red) and lock in the “On” position.

.2 Emergency circuits.

.3 Security System circuits.

2.3 Equipment Identification

.1 Provide equipment identification in accordance with Division 26 - Common Work Results for Electrical.

.2 Nameplate for each panelboard size 4 engraved or as indicated.

.3 Nameplate for each circuit in distribution panelboards size 2 engraved or as indicated.

.4 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in clear plastic envelope at inside of panel door.

2.4 Manufacturers

.1 Schneider (Square D).

.2 Eaton (Cutler-Hammer).

.3 Siemens.

.4 Or approved equal.

3. EXECUTION

3.1 Installation

.1 Mount panelboards to height specified in Division 26, or as indicated on the drawings.

.2 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

.3 Connect loads to circuits.

.4 Connect neutral conductors to common neutral bus [with respective neutral identified].

3.2 Protection

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by panelboards installation.

END OF SECTION

1. GENERAL

1.1 Related Sections

.1 Section 26 28 21, Moulded Case Circuit Breakers.

.2 Section 26 29 10, Motor Starters to 600 V.

.3 Section 26 29 23, Variable Frequency Drives.

1.2 References

.1 Canadian Standards Association (CSA):

.1 Latest approved edition of CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

.2 CSA C22.2 NO. 254.

1.3 Submittals

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

.2 Submit product data sheets for sills, busbars and compartments. Include product characteristics, physical size and finish.

.3 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence, and cleaning procedures.

.4 Submit Shop Drawings indicating the components and equipment to be used:

.1 Outline dimensions.

.2 Configuration of identified compartments.

.3 Floor anchoring method and dimensioned foundation template.

.4 Cable entry and exit locations.

.5 Dimensioned position and size of busbars and details of provision for future extension.

.6 Schematic and wiring diagrams for all systems, including VFDs, motor starters, network communication, etc.

.7 MCC riser/elevation diagram.

.8 Manufacturer installation instructions, testing and Commissioning procedures.

.9 Details on the kirk key interlock system, including part numbers, and logic diagram/table.

.5 Closeout Submittals: provide operation and maintenance data for motor control centre for incorporation into manual specified in Section 01 78 00, Closeout Procedures.

.1 Include data for each type and style of starter.

1.4 O&M Manual

.1 Include all Shop Drawings and product submittals.

2. PRODUCTS

2.1 General

.1 600 VAC, 60 Hz, 3-phase, 3-wire.

.2 Compartmentalized vertical sections with common power busbars.

.3 Floor mounting, free standing, enclosed dead front.

.4 Indoor NEMA 1A, gasketed enclosure, front mounting.

.5 Class IIS (custom, smart MCC), Type B-D and Type B-T as indicated on the drawings.

.6 Nameplates: white with black letters.

.7 The MCC shall be provided with a factory wired and tested intelligent communication system.

2.2 Vertical Section Construction

.1 Independent vertical sections fabricated from rolled flat steel sheets bolted together to form rigid, completely enclosed assembly.

.2 Dimensions: 2324 mm (91.5”) high. MCC depth to be a minimum of 508 mm (20”) or larger to accommodate the motor starters and devices. Standard width to be 508 mm (20”) or larger as required to accommodate devices within the MCC.

.3 Assembled sections into a group having a common power bus and forming an enclosure to which additional sections may be readily added. Design for all power and control connections to be made from the front. All bus and feeder bolted connections shall be accessible from the front.

.4 Sections with horizontal wiring spaces top and bottom and with 102 m full height vertical wiring spaces with cable tie supports. Insulate wireways from horizontal and vertical bus.

.5 Each vertical section divided into compartment units, minimum 152 mm high, as indicated.

.6 Each unit to have complete top and bottom steel plate for isolation between units.

.7 Horizontal wireways, equipped with cable supports, across top and bottom, extending full width of motor control centre, isolated from busbars by steel barriers.

.8 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.

.9 Stab opening protection: removable protective caps.

.10 Isolation barriers between units and wireways.

.11 Openings, with removeable cover plates inside of vertical sections for horizontal wiring between sections.

.12 Incoming cables to enter at top and/or bottom.

.13 Provision for outgoing cables to exit via top and/or bottom.

.14 Removable lifting means.

.15 Provision for future extension of both ends of motor control centre including busbars without need for further drilling, cutting, or preparation in field.

.16 Divide assembly for shipment to site, complete with hardware and instructions for re-assembly. Groupings are to allow for transport of the components into the required electrical room.

.17 Provide all spaces complete with bussing hardware and other accessories required so that additional combination starter units can be readily installed. Provide barriers to isolate the space from all buswork.

.18 Provide barriers to isolate all buswork to prevent accidental contact when starter units are removed or spaces are provided. Barriers shall also provide phase-to-phase isolation of the vertical bus.

2.3 Sills

.1 Continuous channel iron floor sills for mounting bases with 19 mm diameter holes for bolts.

2.4 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 Minimum main horizontal busbar size: 600 A or larger as required.

.2 Minimum branch vertical busbars: 30 0A or larger as required.

.2 Branch vertical busbars for distribution of power to MCC units in vertical sections.

.3 Brace buswork to withstand effects of short circuit current, minimum rating of 42 kA RMS symmetrical or larger as required.

.4 Bus supports: with high dielectric strength, low moisture absorption, high impact material and long creepage surface designed to discourage collection of dust.

.5 Location: Top.

2.5 Ground bus

.1 Tin-plated copper ground bus extending entire width of motor control centre.

.2 Tin-plated copper vertical ground bus, full height of section, tied to horizontal ground bus, engaged by plug0in unit ground stab.

2.6 Transient Voltage Surge Suppressor

.1 Supply and install a transient voltage surge suppressor (TVSS) where shown on the Drawings.

.2 Requirements:

.1 TVSS units and all components shall be designed, manufactured, and tested in accordance with ANSI/UL-1449.

.2 Voltage: Refer to Drawings.

.3 Maximum continuous operating voltage (MCOV): The MCOV shall not be less than 115% of the nominal system operating voltage. In cases where a neutral grounding resistor is part of the distribution, utilize minimum MCOV levels of 700V L-G and L-L. TVSS units shall be specifically designed for operation with an NGR.

.4 The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.

.5 Protection Modes – The TVSS must protect all modes of the electrical system being utilized.

.1 3-phase, 3-wire system: L-L and L-G.

.6 Nominal discharge current (In): Each TVSS applied to the distribution shall have a 20kA In rating regardless of the TVSS type (includes Type 1 and 2). Or operating voltage. Any TVSS with an In less than 20kA shall be rejected.

.7 Voltage protection rating (VPR): The maximum ANSI/UL 1449 3rd edition VPR for the device shall not exceed the following:

.1 L-N, L-G, N-G:

.1 120/208 V: 700 V.

.2 600 V: 1500 V.

.2 L-L:

.1 120/208 V: 1200 V.

.2 600 V: 3000 V.

.3 TVSS Design:

.1 Maintenance-free design: The TVSS shall be maintenance free and shall not require any user intervention throughout its life.

.1 A TVSS containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted.

.2 A TVSS requiring any sort of maintenance such as periodic tightening of connections shall not be accepted.

.3 A TVSS requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

.2 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. Designs incorporating replaceable TVSS modules shall not be accepted.

.3 Electrical noise filter: each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method.

.4 Internal connections: no plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall utilize low impedance conductors.

.5 Monitoring diagnostics: each TVSS shall provide the following integral monitoring options:

.1 Protection status indicators: each unit shall have a green / red solid-state indicator light that reports the status of each protection mode on each phase.

.1 The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode.

.2 All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes.

.3 Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.

.4 Overcurrent Protection:

.1 The unit shall contain thermally protected MOVs. These thermally protected MOVs shall have a thermal protection element packaged together with the MOV to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOV(s) from the system in a fail-safe manner, should a condition occur that would cause them to enter a thermal runaway condition.

.5 Surge Current Capacity – Refer to the Drawings for required capacity. The minimum surge current capacity the device is capable of withstanding shall be as shown:

.1 600 V MCCs – Service entrance: 240 kA.

.2 600 V MCCs – Not Service Entrance: 120 kA or greater.

.6 Installation Requirements:

.1 The TVSS shall be installed immediately following the load side of the main breaker or main switch.

.2 The MCC shall be capable of re-energizing upon removal of the TVSS.

.3 Utilize a breaker, appropriately rated as directed by the TVSS Manufacturer, to connect the TVSS to the MCC. The TVSS shall be located directly adjacent to the circuit breaker.

.4 The TVSS shall be included and mounted within the MCC (where shown on the Drawings) by the Manufacturer of the MCC.

.1 The complete MCC including the TVSS shall be CSA/cUL listed.

2.7 Intelligent Motor Protection Relays

.1 Intelligent Motor Protection Relays (IMPR's) shall be CSA and UL approved.

.2 IMPR's shall be fully programmable electronic relays.

.3 The IMPR shall feature a Test/Rest button.

.4 I/O shall consist of six discrete logic inputs, with a minimum of three relay outputs (1 NO) and one relay output for fault signaling (1 NO + 1 NC) or greater as indicated on the Drawings.

.5 Control voltage shall be 120 VAC.

.6 Network, electronic and manual reset functions shall be supported.

.7 The following status and monitoring functions shall be provided based on user configurable parameters:

.1 Metering:

.1 Measurement:

.1 Line Currents.

.2 Ground current.

.3 Average Current.

.4 Current Phase Imbalance.

.5 Thermal capacity Level.

.6 Motor Temperature Sensor.

.2 Statistics:

.1 Protection Fault Counts.

.2 Protection Warning counts.

.3 Diagnostic fault counts.

.4 Motor Control Function counts.

.5 Fault History.

.3 Diagnostics:

.1 Internal watchdog results.

.2 Controller Internal Temperature.

.3 Temperature Sensor Connections.

.4 Current Connections.

.5 Control Commands (start, stop, run, check back and stop check back).

.6 Control configuration checksum.

.7 Communication loss.

.4 Motor states:

.1 Motor control states motor starter/LO1 starts/ LO2 starts.

.2 Operating time.

.3 Motor starts per hour.

.4 Last start max current.

.5 Last start time.

.6 Time to trip.

.7 Time to reset.

.2 Fault Monitoring:

.1 Diagnostic:

.1 Run command check.

.2 Stop command check.

.3 Run check back.

.4 Stop check back.

.2 Wiring/configuration errors:

.1 PTC Connection.

.2 CT Reversal.

.3 Current Phase Reversal.

.4 Phase Configuration.

.3 Internal:

.1 Stack Overflow.

.2 Watchdog.

.3 ROM Checksum.

.4 EEROM.

.5 CPU.

.6 Internal Temperature.

.4 Motor temperature sensor:

.1 PTC Binary.

.2 PTC Analog.

.3 NTC Analog.

.5 Thermal overload:

.1 Definite.

.2 Inverse Thermal.

.6 Current:

.1 Long Start.

.2 Jam.

.3 Current Phase Imbalance.

.4 Current Phase Loss.

.5 Overcurrent.

.6 Undercurrent.

.7 Internal Ground Current.

.8 External Ground Current.

.7 Communication loss: PLC to IMPR.

.8 Protection: Thermal overload.

.9 Current phase imbalance.

.10 Current phase loss.

.11 Current phase reversal.

.12 Long start.

.13 Jam (locked rotor during run).

.14 Undercurrent.

.15 Overcurrent.

.16 Ground current.

.17 Motor temperature sensor.

.18 Rapid cycle lockout.

.3 Control functions:

.1 Motor control modes:

.1 Local terminal strip.

.2 Network.

.2 Operating mode:

.1 Overload.

.2 Independent.

.3 Reverser.

.4 Two-step.

.5 Two-speed.

.6 Custom mode.

.3 Fault management:

.1 Manual reset.

.2 Automatic reset.

.3 Remote reset.

.8 Metering and Monitoring:

.1 The IMPR shall include accurate measurement processing functions to operate the different applications and carry out Commissioning and maintenance.

.2 For measurement, the IMPR shall include Current transformers up to 100 A, for all measurements required (current, power, voltage, frequency, etc.) It is not possible to use external special CTs for measurement.

.9 Motor protection functions:

.1 The IMPR shall integrate all motor protection functions described above.

.2 The thermal overload trip curve shall be selectable between inverse (I^2t) or definite time (Ixt) curve. The Auxiliary Fan Cooling application shall be also selectable.

.3 It shall include Ground Fault Protection internally, and it shall be possible to use an external zero sequence CT to accomplish this, without the need for additional modules or devices.

.10 Programming configuration software:

.1 The IMPR shall use user-friendly settings and operate multi-lingual software in a Windows environment with menus and icons for fast direct access to the data required, guided navigation to go through all the data for the same function on the same screen and with file management.

.2 The PC can be connected in a 1-to-1 configuration to a single controller, or in a 1-to-many configuration to multiple controllers.

.3 The IMPR shall provide a “Custom Mode”, a logic customized by the end user.

.11 Self-test:

.1 The IMPR shall be capable of self-tests. It shall perform internal checks such as a watch-dog check and RAM check, in order to maximize availability and minimize the risk of malfunctioning.

.12 Acceptable products: Schneider Electric TeSys T.

2.8 Communication cabling

.1 The MCC shall employ a network communication cabling system to interconnect units within the MCC.

.2 Network cabling shall be routed through the lower horizontal wireway to isolate the network from the horizontal bussing routed through the top.

.3 A communication barrier in the full-depth vertical wireway shall serve to separate communications from power cabling and to prevent noise interference on the network cable.

.4 Provisions for appropriate terminators and grounding shall be provided.

.5 Addition, removal, or rearrangement of units shall not interrupt the trunk line and shall not affect the cabling of other units attached to the trunk line.

.6 Cable coupler design shall include a vibration-resistant ratchet to prevent loosening.

.7 The cabling is to be configured in a star configuration.

.8 Cabling shall be Category 6 shielded twisted pair Ethernet cable with RJ45 connector.

.9 Ethernet cable insulation rating shall be 600 V minimum.

2.9 Power Meter

.1 Where indicated on the Drawings, provide a microprocessor-based multifunction power meter.

.2 Requirements:

.1 Multifunction electrical measurement on 3 phase power systems.

.2 Accept a direct voltage input range of up to 600 V Line to Line.

.3 Programmable for current to any CT ratio.

.3 10/100 Mbps Ethernet supporting Modbus-TCP.

.4 Acceptable products:

.1 Schneider Electric PM5500 or PM8000 as indicated on the single lines, front mounted, visible from outside the MCC.

2.10 Network Switches

.1 Type: managed switch.

.2 Speed: 100 mbit or gigabit as required.

.3 Port quantity: as indicated on the Drawings.

.4 Power supply: 24 VDC.

.5 Please include in the MCC spec for the network switch power supplies that one will be fed from a control power transformer within the MCC and one fed from the UPS.

.6 Provide redundant power supplies for each network switch. Two 24 VDC supplies, fed from separate transformers and separate fused disconnects. One will be fed from a control power transformer within the MCC and one fed from the UPS. Each supply shall be brought into the network switches. The UPS feed shall be used to normally power the network switches.

.7 Provide dual power input network switches.

2.11 Motor Starters and Devices

.1 Equip the MCC with combination starters as specified and shown on the Drawings.

.2 Refer to Section 26 29 10, Motor Starters to 600 V.

2.12 Starter Unit Compartments

.1 Units NEMA size 5 and smaller, circuit breaker units 225 A 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.

.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 padlock 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 Manufacturer to facilitate maintenance.

.8 Pull-apart terminal blocks for power and control to allow removal of starter units without removal of field wiring.

.9 Control wiring shall be extended from each starter module to the control terminal section, including all auxiliary contacts. A multi unit style terminal block having screw type terminal connections shall be installed on standoff supports on back plate.

.10 All terminals shall be number coded or otherwise suitably identified to indicate which section or module of the MCC they are associated with and their function.

.11 Complete control wiring diagrams for each starter with conductor identification clearly shown shall be affixed to the interior cover of the starter section or provide a book of wiring diagrams for all starters in each MCC.

.12 Primary and secondary high rupturing capacity (HRC) fusing shall be installed on the control transformer.

.13 Equip door of each individual unit with a removable plate replaceable with similar plate complete with pushbuttons, pilot lights or selector switches as required. Use pilot lights of push-to-test type and push button of heavy-duty oil tight construction.

.14 MCC cabinets with VFD drives shall have integrated keypad flush mounted on the MCC doors.

.15 Ground Fault Protection:

.1 As indicated on Drawings, some MCCs are supplied by transformers incorporating high resistance grounding. Ensure sufficient space for ground fault current transformers in switchgear cells. Refer to the Drawings for details. Supply and install all ground fault C.Ts (including 3rd party C.Ts, in the factory).

.2 For solidly grounded three phase, three-wire systems (with 1000 A or greater main breaker), provide Long Time, Short Time, Instantaneous, and Ground (LSIG) trip breakers for all breakers within the switchgear.

2.13 Finishes

.1 Apply finishes in accordance with Section 26 05 00, Common Work Results - For Electrical.

.2 Paint motor control centre exterior light gray and interiors white.

2.14 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.

.2 Contract Administrator to witness standard factory testing of complete motor control centre including operation of switches, circuit breakers, starters and controls.

2.15 Spare Parts

.1 Two (2) spare Intelligent Motor Protection Relays (overloads) of each type and size. Include two (2) spare add on modules of each type.

.2 One (1) spare 120 kA TVSS unit and one (1) spare 240 kA TVSS unit.

.3 One (1) spare contactor of each size.

.4 One (1) spare circuit breaker of each size for breakers 150 A and smaller. Breakers greater than 150A do not require spares.

.5 One (1) spare Motor Circuit Protector (MCP) of each size.

.6 Four (4) spare pilot lights of each type and rating.

.7 Two (4) spare C.Ts of each type and size for branch feeders.

.8 Two (2) spare C.Ts of each type and size for main and tie breaker C.Ts.

.9 One (1) set of fuses of each type and size.

2.16 Equipment Identification

.1 Provide equipment identification in accordance with Section 26 05 01, Common Work Results – Electrical.

.2 Mark spaces as “SPACE” and spares as “SPARE.

.3 Nameplate for each MCC size 10, example as follows:

MCC-K710 NORMAL POWER 347/600V, 3Ø, 3W FED FROM SGR-K701

.4 Nameplate for each MCC cell, size 8, example as follows:

P-K501 SUMP PUMP

2.17 Approved Manufacturers

.1 Schneider Electric. Alternative Manufacturers will not be accepted because this product is the selected standard.

.2 All equipment shall be sourced from the local Manufacturer’s Representative, through the Manufacturer’s local approved distributors. Sourcing equipment from alternate sources will not be accepted.

3. EXECUTION

3.1 Setup and Testing

.1 Upon completion of assembly, all system components shall be factory-wired and tested as a

.2 system prior to shipment.

.3 Each device shall be configured and addressed to correspond with software settings.

.4 A read/write test shall be performed prior to shipment on all network devices including, but

.5 not limited to, Overloads, Drives, and Soft Starts.

.6 Testing shall be designed to verify system operation and shall include these verifications as a minimum:

.1 I/O addressing.

.2 Correct device operation by I/O address.

.3 Host Communications.

.4 Control Network Interface.

3.2 Installation

.1 Set and secure motor control centre in place on channel bases, rigid, plumb and square to building floor and wall.

.2 Make field power and control connections as indicated.

.3 Install and connect components in accordance with the Drawings and the Manufacturer's instructions.

3.3 Field Quality Control

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

.2 Ensure moving and working parts are lubricated where required.

.3 Include costs of having a Square D factory trained technician inspect and approve the MCC installation prior to system energization.

3.4 Training

.1 Furnish the services of a competent, factory-trained engineer or technician for two (2) sessions of four-hour duration to instruct City electrical maintenance personnel in the operation and maintenance of the equipment, on a date requested by the Contract Administrator.

.1 The contents of the training session to include:

.1 Electrical operation.

.2 Adjustment of overloads.

.3 Racking of buckets.

.4 Power meter use.

.5 All other information deemed pertinent by the Contract Administrator.

.2 Furnish the services of a competent, factory-trained engineer or technician for two sessions, each of two-hour duration to instruct City technical maintenance personnel in the operation and maintenance of the networked equipment, on a date requested by the Contract Administrator. The contents of the training session to include:

.1 Network communications.

.2 Connection to motor starter web interface.

.3 Viewing and adjustment of parameters.

.4 Replacement of motor overload, including setting of IP address.

.5 Troubleshooting and maintenance, and

.6 Similar contents to the training session identified above.

3.5 Testing

.1 Test in accordance with Section 26 08 05, Acceptance Testing, and the Manufacturer's recommendations.

END OF SECTION

WIRING DEVICES

1. GENERAL

1.1 Section Includes

.1 Switches, receptacles, wiring devices, cover plates and their installation.

1.2 References

.1 National Electrical Manufacturers Association (NEMA):

.1 NEMA 250-2014, Enclosures for Electrical Equipment (1000 Volts Maximum).

.2 NEMA ICS 6:1993 (R2011), Industrial Control and Systems: Enclosures.

.2 Canadian Standards Association (CSA):

.1 C22.2 NO. 42-10 (R2015) - General use receptacles, attachment plugs, and similar wiring devices.

.2 C22.2 NO. 42.1-13 - Cover plates for flush-mounted wiring devices (Bi-national standard, with UL 514D).

.3 C22.2 NO. 55-15 - Special use switches.

.4 C22.2 NO. 111-10 (R2015) - General-use snap switches (Bi-national standard, with UL 20).

1.3 Related Sections

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 26 05 00 - Common Work Results for Electrical.

1.4 Submittals

.1 Submit Shop Drawings in accordance with Section 01 33 00 - Submittal Procedures.

2. PRODUCTS

2.1 Manufacturer

.1 Acceptable Manufacturers:

.1 Crouse-Hinds (Eaton).

.2 Hubbell Inc.

2.2 Switches

.1 Switches to be of one manufacturer throughout project.

.2 Manually - operated general purpose AC switches shall have the following features:

.1 Terminal holes approved for AWG # 10 wire.

.2 Silver alloy contacts.

.3 Urea or melamine molding for parts subject to carbon tracking.

.4 Suitable for back and/or side wiring.

.3 Toggle-operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.

2.3 Receptacles

.1 Receptacles to be of one manufacturer throughout project.

.2 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA-C22.2 No.42 with following features:

.1 Ivory urea molded housing.

.2 Suitable for # 10 AWG for back and side wiring.

.3 Eight (8) back wired entrances, four (4) side wiring screws.

.4 Break-off links for use as split receptacles.

.5 Triple wipe contacts and riveted grounding contacts.

.3 Duplex 15 A, 120 V, 3 wire, U-ground ground fault receptacle.

.4 Other receptacles with ampacity and voltage as indicated.

.5 Receptacles located in the wet areas and on the exterior of the building to be weatherproof construction.

2.4 Cover Plates

.1 Cover plates for wiring devices to: CSA-C22.2 No.42.1.

.2 Cover plates to be of one manufacturer throughout project.

.3 Use sheet steel utility box cover for wiring devices installed in surface mounted utility boxes.

.4 Use stainless steel 1 mm thick cover plates on all wiring devices mounted in flush-mounted outlet boxes unless otherwise specified.

.5 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for single receptacles or switches.

.6 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches.

.7 Sheet metal cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

3. EXECUTION

3.1 Installation

.1 Wherever possible, mount equipment in a straight line at a uniform mounting height, coordinated with other equipment and materials.

.2 Mount wiring devices at height in accordance with Section 26 05 00 – Common Work Results for Electrical. Mounting dimensions are to the centre of the devices. Final instructions on mounting heights shall be given by Contract Administrator at the Site. The above shall be used as a guide but shall be subject to final verification prior to installation.

.3 Switches.

.1 Install single throw switches with handle in the "UP" position when switch closed.

.2 Install switches vertically in gang type outlet box when more than one switch is required in one location.

.3 Mount switches on the latch side of the doorway as close as possible to door frame unless otherwise indicated on Drawings.

.4 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results - Electrical.

.4 Receptacles:

.1 Install receptacles in a gang type outlet box when more than one receptacle is required in one location.

.2 Where split receptacle has one portion switched, mount vertically, and switch upper portion.

.3 Mount lighting fixture receptacles local to fixtures.

.4 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results - Electrical.

.5 Cover Plates:

.1 Protect cover plate finish with paper or plastic film until all painting and other Work is finished, and then remove protective covering.

.2 Install suitable common cover plates where wiring devices are grouped.

.3 Do not distort plates by tightening screws excessively.

.4 Do not use cover plates meant for flush outlet boxes on surface mounted boxes.

END OF SECTION

MOULDED CASE CIRCUIT BREAKERS

1. GENERAL

1.1 Section Includes

.1 Materials for moulded-case circuit breakers, circuit breakers, and ground-fault circuit-interrupters.

1.2 References

.1 Canadian Standards Association (CSA):

.1 Latest approved edition of CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

.2 CSA C22.2 No. 5-02, 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).

1.3 Related Sections

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 26 05 00 - Common Work Results - Electrical.

1.4 Submittals

.1 Submit Shop Drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Include time-current characteristic curves for breakers with minimum symmetrical (rms) interrupting capacity as shown and over at system voltage.

2. PRODUCTS

2.1 Breakers General

.1 Moulded case circuit breakers, arc-fault circuit-interrupters, and ground-fault circuit interrupters: to CSA C22.2 No. 5.

.2 Bolt-On Moulded Case Circuit Breaker: quick-make, quick-break type, for manual and automatic operation 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.

.1 Trip settings on breakers with adjustable trips to range from three (3) to eight (8) times current rating.

.5 Circuit breakers with interchangeable trips as indicated.

.6 Circuit breakers shall clearly indicate fault current withstand ratings.

.7 Lock-on devices shall be provided for the following systems:

.1 Egress and Emergency Lighting.

.2 Any other breakers as indicated on the drawings.

2.2 Thermal Magnetic Breakers

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

2.3 Magnetic Breakers

.1 Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection.

3. EXECUTION

3.1 Installation

.1 Install circuit breakers as indicated.

END OF SECTION

DISCONNECT SWITCHES FUSED AND NON-FUSED UP TO 600 V PRIMARY

1. GENERAL

1.1 Section Includes

.1 Provide disconnect switches for 600 V and 120/240 V distribution as indicated on the Drawings.

1.2 References

.1 National Electrical Manufacturers Association (NEMA):

.1 NEMA 250 - 2014, Enclosures for Electrical Equipment (1000 Volts Maximum).

.2 NEMA ICS 6: 1993 (R2011), Industrial Control and Systems: Enclosures.

.2 Canadian Standards Association:

.1 CAN/CSA C22.2 No.4-M89, Enclosed Switches.

.2 CSA 22.2 No.39-M89, Fuseholder Assemblies.

1.3 Related Sections

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 26 05 00 - Common Work Results for Electrical.

1.4 Submittals

.1 Submit Shop Drawings in accordance with Section 01 33 00 - Submittal Procedures.

2. PRODUCTS

2.1 Disconnect Switches

.1 Ratings: Ampere ratings as shown on the Drawings or to suit load requirements. For motors, use disconnects switches with HP ratings at least equal to motor HP.

.2 Provide ON-OFF switch position indication on switch enclosure cover.

.3 NEMA Type according to Section 26 05 00 - Common Work Results for Electrical.

.4 Finish: one (1) primer coat and one (1) finish coat on all metal surfaces, colours as per Section 26 05 00 - Common Work Results for Electrical.

.5 Switch mechanisms: quick-make and quick-break action with self-wiping contacts, solderless pressure lug connectors.

.1 For switches 100 A and over, provide non-tracking arc shrouds.

.2 All switch poles to operate together from a common operating bar.

.6 Provide for padlocking disconnect switches in OFF position by three (3) locks. Doors to be interlocked and complete with defeat mechanism, to prevent opening when handle in ON position.

.7 Where required (namely for VFDs) provide an auxiliary contact on the disconnect such that the contact breaks prior to main contacts. Interlock auxiliary contact with emergency stop of associated motor.

.8 Neutral Bars: where distribution system has grounded neutral conductor, provide neutral bar where required with ampere rating equal to switch rating, in enclosure. Provide ground bar for terminating ground conductors.

.9 Fuse Holders: to CSA C22.2 No.39 relocatable and suitable without adaptors, for type and size of fuse indicated.

.10 Approved Manufacturers:

.1 Eaton.

.2 Schneider Electric.

.3 Siemens.

2.2 Fuses

.1 Size as indicated.

.2 Fuses feeding motors to be of the time delay type.

.3 Provide one (1) full set of spare fuses, three (3) for each different ampere rating used, stored in suitable enclosure.

2.3 Equipment Identification

.1 Identification: provide lamacoid plate in accordance with Section 25 05 00, on each switch showing voltage, source of supply and load being fed, for example:

DOOR CONTROLLER 120/240 V FED FROM PPA

.2 Indicate name of load controlled on size 4 nameplate.

3. EXECUTION

3.1 Installation

.1 Install disconnect switches complete with fuses if applicable.

.2 Mounting: provide supports independent of conduits. Wall-mount where possible, otherwise provided Unistrut frame support. Where switches are grouped mount in uniform arrangement.

.3 Wiring: connect line and load cable to all switches.

.4 Fuse Rating: install so that rating is visible.

END OF SECTION

CONTROL DEVICES

1. GENERAL

1.1 Section Includes

.1 Materials and installation for industrial control devices including pushbutton stations, control and relay panels.

1.2 References

.1 National Electrical Manufacturers Association (NEMA):

.1 NEMA 250 - 2014, Enclosures for Electrical Equipment (1000 Volts Maximum).

.2 NEMA ICS 6: 1993 (R2011), Industrial Control and Systems: Enclosures.

.3 NEMA ICS 1-2000 (R2015), Industrial Control and Systems: General Requirements.

.2 Canadian Standards Association (CSA):

.1 C22.2 NO. 14-18 - Industrial Control Equipment.

1.3 Related Sections

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 26 05 00 - Common Work Results for Electrical.

1.4 Submittals

.1 Submit Shop Drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Include schematic, wiring, interconnection diagrams.

2. PRODUCTS

2.1 Enclosure

.1 NEMA 1 electrical rooms, area control rooms, offices.

.2 NEMA 3R (minimum) in outdoor areas.

.3 NEMA 4X in process areas.

2.2 AC Control Relays

.1 Control Relays: to CSA C22.2 No.14 and NEMA ICS 1.

.2 Convertible contact type: contacts field convertible from NO to NC, electrically held permanent magnet latched or double-voltage type with sliding barrier to permit access to contacts only or coil only as indicated, solid state timer and poles overlap type.

2.3 Relay Accessories

.1 Standard contact cartridges: normally open - convertible to normally closed in field.

2.4 Pushbuttons

.1 Heavy duty oil tight. Operator extended or mushroom type. Black and Green, with 1-NO and 1-NC contacts rated as required, labels as indicated.

.2 Stop pushbuttons coloured red, provision for padlocking in depressed position, labelled "Emergency Stop" on lamacoid with large white letters on red background.

2.5 Selector Switches

.1 Maintained, 2 or 3 position labelled as indicated heavy-duty oil tight, operator's wing lever, contact arrangement as indicated, rated as required.

2.6 Indicating Lights

.1 Heavy-duty oil tight, transformer light emitting diode (LED) type, push-to-test, lens colour: as indicated, supply voltage: as required, lamp voltage: as required, labels as indicated.

2.7 Control and Relay Panels

.1 CSA Type 1 sheet steel enclosure with hinged padlockable access door, accommodating relays timers, labels, as indicated, factory installed and wired to identified terminals.

2.8 Thermostat (Line Voltage)

.1 Wall mounted, for exhaust fan control.

.2 Full load rating: 8 A at 120 V.

.3 Markings in 5-degree increments.

3. EXECUTION

3.1 Installation

.1 Install pushbutton stations, control and relay panels, control devices and interconnect.

3.2 Field Quality Control

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

.2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at a time and check out operation of section.

.3 Upon completion of sectional test, undertake group testing.

.4 Check out complete system for operational sequencing.

.5 Submit to Contract Administrator one (1) copy of test results.

END OF SECTION

1. GENERAL

1.1 Codes and Standards

.1 CSA, Canadian Standards Association.

.2 NEMA, National Electrical Manufacturer Association.

1.2 Related Sections

.1 Section 26 24 19, Motor Control Centers.

1.3 Submittals

.1 Provide Submittals in accordance with Section 01 33 00, Submittal Procedures and Section 26 05 00, Common Work Results – Electrical.

.2 Product Data:

.1 Submit Manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Submit Shop Drawings to indicate:

.1 Mounted method and dimensions.

.2 Starter size and type.

.3 Layout and components.

.4 Enclosure type.

.5 Bill of Materials.

.6 Wiring and schematic diagram.

1.4 Maintenance

.1 Provide maintenance materials for incorporation into O&M manuals in accordance with Section 01 78 23.

.2 Submit operation and maintenance data for each type and style of motor starter for incorporation into maintenance manual.

2. PRODUCTS

2.1 Manual Motor Starters

.1 Manual starters with overloads of size and rating as required. Enclosure type as required to suit the environment. Include components as follows:

.1 Switching mechanism, quick make and break.

.2 Overload heaters, manual reset, trip indicating handle.

.2 Accessories:

.1 Indicating light: LED type, green run light.

.2 Locking tab to permit padlocking in "ON" or "OFF" position.

.3 Approved manufacturers:

.1 Non-Hazardous areas: Square D, NEMA 4, class 2510.

2.2 Full Voltage Magnetic Starters

.1 UL/CSA listed, NEMA size as shown on the drawings.

.1 Smallest size starter: NEMA 1, unless otherwise indicated.

.2 IEC rated starters are not acceptable.

.2 Magnetic of size, type, rating and enclosure type as indicated with components as follows:

.1 Combination style motor starter, with instantaneous overcurrent protection, starter contactor, overload protection.

.2 Smart motor starter contactor / overload protective device:

.1 Electronic overloads, manually reset from outside enclosure.

.2 Modbus TCP over Ethernet communications.

.3 Wiring and schematic diagram inside starter enclosure in visible location.

.4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.

.5 Transient suppressors shall be supplied for all coils in each individual starter unit.

.3 Approved manufacturer: Schneider Electric TeSys T.

2.3 Control Transformer

.1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V secondary, complete with primary and secondary fuses, installed in with starter as indicated on Drawings.

.2 Size control transformer as indicated on Drawings.

2.4 Accessories

.1 Pushbuttons and selector switches:

.1 Heavy duty, oil tight, colour as indicated.

.2 Model: Schneider Electric Harmony XB4 series.

.2 Indicating lights:

.1 Heavy duty, oil tight, colour as indicated.

.2 LED type.

.3 Model: Schneider Electric Harmony XB4 series.

2.5 Finishes

.1 Apply finishes to enclosure in accordance with Section 26 05 00, Common Work Results – Electrical.

2.6 Equipment Identification

.1 Provide equipment identification in accordance with Section 26 05 00, Common Work Results – Electrical.

.2 Magnetic starter lamacoid: white plate, black letters, size 7 engraved with load identifier and load description. Example as followed:

P-K661 HOT WATER PUMP

2.7 Spare Parts

.1 Fuses: two (2) of each type and rating.

.2 Indicating lights: two (2) LED style indicating light of each type.

.3 Relays: two (2) relays of each type (base not required).

3. EXECUTION

3.1 Installation

.1 Install starters and control devices in accordance with Manufacturer's instructions.

.2 Install and wire starters and controls as indicated.

.3 Ensure correct fuses installed.

.4 Confirm motor nameplate and adjust overload device to suit.

3.2 Field Quality Control

.1 Perform tests in accordance with Section 26 05 00, Common Work Results - Electrical and Manufacturer's instructions.

.2 Operate switches and contactors to verify correct functioning.

.3 Perform starting and stopping sequences of contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

3.3 Configuration

.1 Configure motor starter parameters as required to meet design requirements. Refer to Motor Schematics, Functional Requirements Specifications, and other Contract Documents for design requirements.

.2 Provide the following configuration for all motor starters, unless shown otherwise:

.1 On loss of communication, the motor starter should stop the motor.

.2 All faults should be reset by a pushbutton on the front of the MCC bucket connected to an input on the MMC, unless otherwise noted.

.3 For starters within “Disconnect Closed” inputs, this signal is to activate the “Not Ready” status.

.4 Motor Starter Parameter List:

.1 Create and maintain a Motor Starter Parameter List which includes all motor starters. The list shall contain all relevant parameters for motor operation including, but not limited to, all parameters that are different than factory defaults.

.2 The list is to be submitted to the Contract Administrator prior to factory testing.

.3 The list is to be update during construction and submitted to the Contract Administrator upon completion of commissioning.

END OF SECTION

VARIABLE FREQUENCY DRIVES

1. GENERAL

1.1 Codes and Standards

.1 CSA, Canadian Standards Association.

.2 NEMA, National Electrical Manufacturer Association.

.3 IEEE, The Institute of Electrical Engineers.

.4 Other, Local Power Utility and Telephone Utility Guidelines for Harmonic Distortion.

1.2 Submittals

.1 Provide Submittals in accordance with Section 01 33 00, Submittal Procedures and Section 26 05 00, Common Work Results - Electrical.

.2 Submit Shop Drawings:

.1 Physical layout in MCC or layout of separate enclosure as applicable.

.2 Wiring diagram showing terminal blocks and terminal numbers.

.1 Provide AutoCAD version of the VFD Drawings upon request.

.3 Material list.

.4 Front panel detail.

.5 Recommended spare component list.

.6 Recommended breaker (molded case switch) & fuse size.

.7 Cooling system and heat rejection calculations for each size / type of VFD.

.8 Completed VFD settings sheets.

.3 Product Data:

.1 Submit Manufacturer’s printed product literature, specifications and datasheets and include product characteristics, performance criteria, and limitations

.4 Settings Sheet:

.1 Contractor shall provide Variable Frequency Drive Settings Sheets with the O&M manual submission for each VFD.

1.3 Design Requirements

.1 Ventilation system designed for ambient temperature range of 10°C to 35°C. Temperature within the enclosures not to exceed 45°C.

.2 Ventilation system filters.

.3 Ensure wiring and design is appropriate for the type of distribution from which the drives are fed. Where VFDs are fed from high resistance grounded systems (i.e. systems with NGRs), isolate the RFI filters from ground in accordance with the Manufacturer's recommendations.

1.4 Maintenance

.1 Provide maintenance materials for incorporation into O&M manuals in accordance with Section 26 05 00, Common Work Results – Electrical.

1.5 Quality Assurance

.1 Prior to shipment, the Manufacturer shall functionally test the AC drive. The inverter shall be tested by running at full nominal load with a motor.

.2 The Manufacturer shall provide a factory certified test report along with the VFD.

2. PRODUCTS

2.1 Variable Frequency Drives

.1 Voltage Input: 600 VAC or other voltage as per the Drawings.

.2 Variable Frequency Drives to be:

.1 CSA Approved.

.2 3-Phase.

.3 Complete with line and load reactors/filters as indicated herein, and as shown on the Drawings.

.1 Line reactors to be a minimum of 3%Z or higher as indicated on the single line drawings.

.4 Designed to provide output requirements dictated by the speed/torque characteristics of motor and driven equipment over the entire speed range.

.5 Capable of re-accelerating the driven equipment, following voltage dips greater than 20% of the rated input power supply, of up to five (5) seconds duration, without the need to come to a complete stop. Vendor shall indicate the maximum time delay before re-acceleration.

.6 Capable to continue operation without coming to a standstill or resulting in a process shutdown, following any momentary voltage dips in the input power supply, auxiliary power supply, or both, of less than 20% rated voltage, which last for less than 0.5 second.

.3 Variable speed controller shall be electronic and allow for the adjustment of frequency and voltage output of the unit.

.4 Motors 75 kW and less to employ a minimum 6-pulse pulse width modulated (PWM) inverter system utilizing Insulated Gate Bipolar Transistors (IGBT) power switching devices.

.5 VFD shall convert the line input power to adjustable AC voltage and frequency output power.

.6 The output power shall be controlled such that permissible volts/Hertz ratio is not exceeded throughout the specified operating speed range, over a voltage range of plus or minus10% and frequency variation of plus or minus 5%.

.7 The VFD output frequency shall not deviate more than plus or minus 1% of any given set point within the operating frequency range.

.8 The VFD shall include radio interference suppression and limit radio interference values to within the limits of local code requirements.

.9 The telephone influence factor shall be in accordance with maximum values specified by local authorities.

.10 Accessories:

.1 Integral flush mounted keypad on the enclosure door (MCC cabinet or standalone enclosure) for programming, monitoring, and operating the drive, accessible through password or other acceptable security measure only.

.2 Integral selector switches and pushbuttons for control on enclosure door.

.1 Standard of acceptance, Square D Harmony XB4 series, or approved equal in accordance with B8.

.3 Selector switches and pushbutton as follows:

.1 Hand/Off/Remote three position-maintained selector switch at the equipment.

.2 VFD/bypass two position-maintained selector switch, if indicated on Drawings.

.3 Manual speed potentiometer, if indicated on Drawings.

.4 Local Emergency Stop button, if indicated on Drawings.

.4 Communication Card: Provide Ethernet connection to all VFDs except for HVAC packaged systems. VFDs integral with packaged HVAC equipment (where a central controller has Ethernet Modbus TCP communication) do not require the communication card.

.11 Diagnostics features:

.1 Integral long life LED indicating lights on enclosure door.

.1 Standard of acceptance, Square D Harmony XB4 series.

.2 Indicating lights as follows:

.1 Running (Green).

.2 VFD Fault (Amber).

.3 Overload Tripped (Amber).

.12 Environmental capabilities: Drive to operate without mechanical or electrical damage under a combination of conditions as follows:

.1 Room ambient temperature: 0°C – 35°C.

.2 Humidity: 0 to 90% (non-condensing).

.3 Vibration: up to 0.5 g.

.4 Altitude: 0 to 1250 m above sea level.

.13 Protective functions to be incorporated are:

.1 VFD failure.

.2 Ground fault in VFD.

.3 Ground fault on converter output.

.4 VFD overcurrent.

.5 Supply system over or under voltage.

.6 Supply system phase voltage unbalance.

.7 DC link fault.

.8 Voltage/frequency ratio incorrect.

.9 5% frequency deviation from the set point.

.10 Loss of control signal.

.11 Control electronics fault.

.12 Electronics motor overload protection adjustable up to 150% of motor rating for 60 seconds.

.13 Motor stalled.

.14 Inverter over temperature.

2.2 Cabling

.1 Provide VFD rated cabling on load side of VFD in accordance with Section 26 05 21, Wires and Cables (0-1000 V).

2.3 Bypass Starter and Overload

.1 Provide bypass system only where indicated on Drawings. Bypass system will be utilized on VFD driven motor load that are deemed critical and do not have a system redundancy arrangement with another motor load.

.2 The bypass would consist of a starter contactor and overload.

.3 Bypass starter should be interlocked with VFD to ensure only one is operating at a time.

.4 Overload to be resettable from enclosure door.

.1 Label as follows:

OVERLOAD RESET FOR BYPASS STARTER

2.4 Load Reactor

.1 VFD load reactors shall be installed for all motors where cabling between the VFD and motor exceeds 30 m.

.2 The equipment Manufacturer to provide standard sized load reactors unless specifically noted otherwise on the Drawings.

.3 Reactor shall not exceed its temperature limit under all operation conditions.

2.5 Filters

.1 DV/DT Filters shall be installed where power cables between the VFD and the motor exceed 150 m or where recommended by the VFD vendor for the specific size and application.

.2 Size filter for the given load.

2.6 Fuses

.1 Fuses for branch circuit protection to be fast acting Class J or as specified on Drawings.

.2 Fuses shall be installed with a molded case switch. Size accordingly based on load rating.

2.7 Wire Colour Coding

.1 Utilize the following wire colours for the types of voltage/signals indicated:

.1	120 VAC Line:	Black
.2	120 VAC Control	Orange
.3	120 VAC Neutral	White
.4	24 VDC Supply:	Blue

.5	24 VDC Control:	Blue
.6	24 VDC Common:	Blue
.7	24 VAC Supply:	Blue
.8	24 VAC Control:	Blue
.9	24 VAC Neutral:	White
.10	10 VDC Supply:	Blue
.11	0-10 VDC Signal:	Blue
.12	10 VDC Common:	Blue
.13	Intrinsically Safe:	Light Blue
.14	4-20 mA Signal:	Blue

2.8 Cooling system

.1 The equipment Manufacturer shall perform heat load analysis to determine air-cooling requirements.

.2 Air-cooled converters shall meet the following:

.1 Redundant cooling fans.

.2 Cooling fan operates when motor is started from VFD or bypass system or when enclosure reaches temperature set point.

.3 Provides adjustable the level set at the temperature switch, with minimum range 10°C to 30°C.

.4 All VFD components shall be rated to operate at full capacity, with full component life expectancy, at 60°C at the components / circuit board level (and at 40°C ambient temperature within the enclosure).

.5 The VFD cooling and heat sink system capacity shall be designed and sized to bring the ambient temperature within the VFD enclosure below 40°C with all components running at full load, and with an electrical room ambient of temperature of 35°C.

END OF SECTION

1. LIGHTING

1.1 Codes and Standards

.1 Canadian Standards Association.

.2 Underwriters Laboratories of Canada (ULC).

.3 IES LM79 & LM80.

1.2 Submittals

.1 Provide submittals in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit Manufacturer's printed product literature, specifications and datasheets and include product characteristics, performance criteria, and limitations.

.3 Include equipment catalog numbers and fixture type on all submitted Shop Drawings.

1.3 Quality Assurance

.1 All equipment and materials are to be new and CSA approved.

2. PRODUCTS

2.1 General

.1 Luminaires to be CSA approved.

.2 Provide supporting devices, plaster frames, junction boxes and outlet boxes where required.

.3 Where soffits or ceilings have thermal insulation, provide fixtures which are CSA approved for such use.

.4 Luminaire types shall be as indicated on the Drawings. In general, the Facility shall have several different luminaire types, which include fluorescent as well as LED. A request for equal from a different luminaire Manufacturer/vendor shall be submitted and approved (if deemed to be equal by the Contract Administrator) in accordance with the Contract Documents prior to tender close.

.5 Refer to the Drawings for the fixture types, manufacturer, and model numbers.

2.2 Fluorescent Lamps

.1 Provide lamps for all fixtures as applicable.

.2 Fluorescent lamps shall be F32T8 or to suit the luminaire.

.3 Burn in fluorescent lamps for a minimum of 100 hours prior to switching in order to burn off all impurities.

2.3 Fluorescent Ballasts and Accessories

.1 Provide ballasts and accessories to suit the fixture type. Ballasts shall be Manitoba Hydro power smart approved.

.2 Provide ballasts with non-PCB type capacitors with pressure sensitive devices to prevent rupturing.

.3 Provide discreet electronic rapid start 120 V fluorescent ballasts, automatic reset thermal protected, 90% power factor, group A noise rating. Only Premium High Efficiency approved ballasts will be accepted.

2.4 LED Lighting

.1 Refer to luminaire schedule on the Drawings for acceptable products.

.2 General Requirements:

.1 Voltage Rating: As indicated on Drawing.

.2 Power rating: As indicated on Drawings.

.3 Input Frequency: 60 Hz.

.4 Correlated Color Temperature (CCT): minimum 4000K.

.3 Indoor lighting:

.1 L70 at 60 000 hours or greater.

.2 Color Rendering Index (CRI): >= 80.

.3 NEMA 4X or approved equal in accordance with B8.

.4 Aluminum or stainless steel housing.

.4 Hazardous Locations, Class 1, Division 1.

.1 L70 at 60 000 hours or greater.

.2 Color Rendering Index (CRI): >= 70.

.3 Aluminum housing.

.4 Class 1, Division 1 rated.

.5 Hazardous Locations, Class 1, Division 2.

.1 L70 at 60 000 hours or greater.

.2 Color Rendering Index (CRI): >= 70.

.3 Aluminum housing.

.4 Class 1, Division 2 rated.

.6 Outdoor Lighting

.1 L70 at 54 000 hours.

.2 Correlated Color Temperature (CCT): minimum 4000K.

.3 Color Rendering Index (CRI): >= 70.

.4 Ambient Operating Temperature: -40°C -55°C.

2.5 Finish

.1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

3. EXECUTION

3.1 Manufacturer's Instruction

.1 Comply with the Manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 Installation

.1 General:

.1 The Contractor is responsible for upsizing conductors to account for voltage drop. Conductor sizes as described on the Drawings, cable schedules and elsewhere are minimum size, and are highly dependent on specific cable routing. The contractor shall upsize wiring as required to meet the requirements herein, and to comply with CEC requirements.

.2 Calculate voltage drop based on 80% of the breaker rating.

.2 Locate and install luminaires as indicated on Drawings.

.3 Luminaires shall be installed in accordance with the Manufacturer's recommendations and the requirements herein. Each luminaire shall be solidly and rigidly installed so that the fixture does not move or swing. Acceptable means of support include:

.1 Rigid Aluminium Conduit/Pipe.

.2 Threaded Rod.

.3 Cantruss.

.4 Wire and connect fixtures using 12 AWG or larger, RW90 run in conduit. Conduit to be as specified in Section 26 05 34, Conduits, Conduit Fasteners and Conduit Fittings.

.5 Short flexible connections less than 2 meters in length to luminaires may be HL rated TECK90 cable.

.6 Drawings do not show conduit routing or conduit sizes and wire counts. Supply and install a complete system of conduit and wire for the lighting system. Make all connections and install all conductors for the switching and branch circuiting indicated and required.

.7 Conduits shall be sized in accordance with CEC requirements for wire counts installed. Conduit size shall be 21 mm or greater. Conductors shall be de-rated according to code requirements. Upsize conductors as required to meet CEC and voltage drop requirements.

.8 Install a permanent label or lamacoid for all luminaires indicating the circuit(s) connected.

3.3 Luminaire Supports

.1 Provide adequate support to suit ceiling or wall mounted luminaires.

3.4 Control

.1 As indicated on drawings.

3.5 Field Quality Control

.1 Operate each fixture after installation and connection. Each fixture shall be inspected for proper connection and operations.

.2 Perform testing of all lighting systems.

.3 Completely clean the exterior, interior, lamps, lenses, etc. of all luminaires after construction and prior to turning over to the City.

3.6 Protection

.1 Lighting fixtures, once installed, shall be protected from damage during the remainder of the construction period. Make good and replace any damages occurring during construction.

.2 Damage to luminaires occurring during construction shall be replaced by the Contractor at the Contractor’s expense. The decision as to what constitutes a damaged fixture which requires replacement is at the discretion of the Contract Administrator.

END OF SECTION

EMERGENCY LIGHTING

1. GENERAL

1.1 Section Includes

.1 Materials and installation for emergency lighting systems.

1.2 References

.1 Canadian Standards Association (CSA):

.1 CSA C22.2 No. 141-10, Emergency Lighting Equipment.

.2 CSA 22.2 No. 107-3, Uninterruptible Power Systems.

.3 Latest approved edition of CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

.2 UL 942, Standard Emergency Lighting and Power Equipment.

.3 SOR/86-304, Canadian Occupational Health and Safety Regulations.

.4 Illuminating Engineering Society of North America (IESNA).

1.3 Related Sections

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 26 05 00 - Common Work Results for Electrical.

.3 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.4 Submittals

.1 Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures and Section 26 05 00 – Common Work Results for Electrical.

.2 Product Data:

.1 Submit Manufacturer’s printed product literature, Specifications and datasheets and include product characteristics, performance criteria, and limitations.

.3 Submit Shop Drawings to include:

.1 System configuration with single-line diagrams.

.2 Wiring diagrams, indicating terminal numbers.

.3 Over-current protection decides, indicating recommended breaker sizes.

.4 A complete set of equipment drawings.

.5 Equipment Specifications, including weights, dimensions, and head dissipation.

.6 Capacity data.

.7 Descriptions of equipment to be furnished.

.8 Size and weight of shipping units to be handled by installing contractor.

.9 Bill of materials and recommended spare parts list.

.10 Detailed installation procedures.

.11 Instruction manuals. Manuals shall include a functional description of the equipment, installation instruction, safety precautions, step-by-step operating procedures and routine maintenance guidelines, including illustrations.

.12 Manufacturer recommended Field Commissioning and Test Procedures.

1.5 Closeout Submittals

.1 Provide data for incorporation into operation and maintenance manual. Operations and Maintenance manual to include:

.1 Operation and maintenance instructions concerning design elements, construction features, component functions and maintenance requirements to permit effective operations maintenance and repair.

.2 Testing and Commissioning report, both factory test and site testing reports.

1.6 Quality Assurance

.1 Before shipment, the Manufacturer shall fully and completely test the system to assure compliance with the Specification.

1.7 Warranty

.1 For batteries, the twelve (12) months warranty period prescribed in subsection GC32.1 of General Conditions "C" is extended to 120 months, with no-charge replacement during the first five (5) years and pro-rate charge on the second five (5) years.

2. PRODUCTS

2.1 Equipment

.1 Emergency lighting equipment: to CSA C22.2 No.141.

.1 Supply voltage: 120 VAC.

.2 Operating time: 30 min.

.2 All emergency lighting to be LED.

.3 All emergency lighting to be rated for the environment in which it is installed.

.4 A 24 VDC battery bank with two LED lighting heads to be provided as required for each area. Battery banks shall be sized to power connected loads as per the Building Code.

.1 Battery: sealed, maintenance free.

.2 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01V for plus or minus 10% input variations.

.3 Solid state transfer circuit.

.4 Low voltage disconnect solid state, modular, operates at 80% battery output voltage.

.5 Lamp heads: integral on unit and 180 degrees vertical adjustment. Lamp type: tungsten 18 W.

.6 Signal lights: solid state, for 'AC Power ON' and 'High Charge'.

.7 Cabinet: suitable for direct or shelf mounting to wall and complete with knockouts for conduit. Removable or hinged front panel for easy access to batteries.

.8 Finish: white.

.5 Auxiliary equipment:

.1 Test switch.

.2 Time delay relay.

.3 Battery disconnect device.

.4 AC input and DC output terminal blocks inside cabinet.

.5 Cord and single twist-lock plug connection for AC.

.6 RFI suppressors.

.6 Provide zone sensing such that failure of a normal lighting circuit will cause emergency lighting in the area served by the failed circuit to illuminate.

2.2 Equipment Identification

.1 Provide equipment identification in accordance with Section 26 05 01, Common Work Results for Electrical.

2.3 Wiring

.1 Provide all AC/DC wiring for emergency lighting as per current edition of Manitoba Building Code.

.2 Conduit: Rigid Aluminum or PVC, in accordance with Section 26 05 34 - Conduits, Conduit Fasteners and Conduit Fittings, and Table 4-4 of the City of Winnipeg Electrical Design Guide.

.3 Conductors: type in accordance with Section 26 05 21 - Wires and Cables 0-1000 V, sized as indicated in accordance with manufacturer's recommendations.

3. EXECUTION

3.1 Manufacturer’s Instruction

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

3.2 General

.1 Emergency lighting will be located in compliance with the Code.

.2 Illumination levels will generally follow IESNA guidelines, Manitoba Building Code, and Canadian Occupational Health and Safety (SOR/86-304). Where these regulations and guidelines conflict, comply with the most stringent condition.

3.3 Installation

.1 Install unit equipment and remote mounted fixtures.

.2 Direct heads.

END OF SECTION

EXIT SIGNS

1. GENERAL

1.1 References

.1 SOR/86-304, Canadian Occupational Health and Safety Regulations.

.2 Illuminating Engineering Society of North America (IESNA).

.3 Canadian Standards Association (CSA):

.1 Latest approved edition of CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

1.2 Submittals

.1 Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures and Section 26 05 00 – Common Work Results for Electrical.

2. PRODUCTS

2.1 Equipment

.1 Exit signs to be of the green pictogram style (“running man”).

.2 Exit signs and to be rated for the environment in which they are installed.

.1 Exit signs installed in process areas to be NEMA 4X.

.3 Provide all AC/DC wiring for exit signs as per current edition of Manitoba Building Code.

.4 Provide 4 additional twin emergency lighting heads in contract and allow for 100' of wiring for each unit.

.5 Non-Hazardous Industrial Locations.

.1 NEMA-4X rated.

.2 White light-emitting diode (LED).

.3 Voltage input: 347 VAC.

.4 Less than 2.5 W.

.5 Equipment frame: Industrial grade polyvinyl chloride.

.6 Faceplate: Sealed heavy duty, vandal-resistant polycarbonate.

.7 Single or double face option. Shall include straight, right, and left faceplates.

3. EXECUTION

3.1 General

.1 Exit signs will be located in compliance with the Code.

.2 Illumination levels will generally follow IESNA guidelines, Manitoba Building Code, and Canadian Occupational Health and Safety (SOR/86-304). Where these regulations and guidelines conflict, comply with the most stringent condition.

3.2 Installation

.1 Install exit signs to Manufacturer's recommendations, listing requirements, NFPA standard and local regulatory requirements.

.2 Install exit signs at locations with direct arrows to suit the location, with single or double face as noted on Drawings. Provide all mounting devices, orientation, supports and installation.

.3 Exit signs indicated on the Drawings are shown at their approximate location. The Contractor is to provide mounting supports and is to adjust the exact location and mounting elevation in order to provide a clear field of view to the exit sign. Exit signs which are blocked by equipment or blocked due to location will not be accepted and shall be relocated at no additional cost in order to be clearly visible.

.4 Connect fixtures to exit light circuits using 12 AWG or larger TECK90 wire. Wire and connect exit signs using conduit as specified in Section 26 05 34, Conduits, Conduit Fasteners, and Conduit Fittings.

.5 The Contractor is to ensure that the exit signs are located in a manner such that they are visible throughout the required floor area. Coordinate location with other trades. Make location adjustments to suit at no additional cost.

.6 Provide tests in accordance with Section 26 08 05, Acceptance Testing.

END OF SECTION

DEWATERING OF EXCAVATIONS

1. GENERAL

1.1 Scope

.1 This Section specifies the requirements for dewatering of excavations.

1.2 Related Work In Other Sections

.1 The following related Sections are included for reference only. It is the Contractor's responsibility to coordinate and include all Works described, shown, and referenced in the Contract Documents.

.1 Section 01 33 00 – Submittal Procedures.

.2 Section 33 05 05 – Excavation, Trenching, and Backfilling.

1.3 Measurement and Payment

.1 Dewatering of construction site and trenches will not be measured or paid for dewatering will be incidental to the Work performed.

1.4 Protection

.1 Prevent damage to trees, landscaping, fencing, natural features, benchmarks, existing structures, pavement, surface or underground utility lines both on and off site, which are to remain. Make good any damage.

.2 The impact of dewatering on the potential settlement of existing structures is a concern. The impact will be reduced if both the duration and drawdown levels of dewatering are minimized.

.3 If groundwater elevations are lowered below that required for construction the City will assess and charge the cost for the repair and restoration of existing structures to the Contractor.

1.5 Submittals

.1 All submittal to be in accordance with 01 33 00 – Submittal Procedures.

.2 Submit a detailed plan of the proposed dewatering system to the Contract Administrator at least four (4) weeks prior to commencing work. Submittal to bear the seal of a qualified Professional Engineer registered in the Province of Manitoba.

.3 Include the following in the detailed plan:

.1 Plan layout showing the arrangement and location of wells/well points, methods of installation, location of headers and discharge lines and points of discharge disposal.

.2 Back-up system including contingency measures if part or all of the dewatering system fails.

.3 Temporary drainage and pumping facilities.

.4 Dewatering construction staging.

.5 Details of well/well point installation including depth, screen dimension, screen slot size, backfill filter gradation, riser dimensions, pump type and capacity, and header dimensions.

.6 Locations of piezometers and details of installation including depth, backfill, tip type and dimensions, riser pipe.

.7 Estimate of flow rate and duration of dewatering.

.8 Details of plugging method for any piezometers installed within structure footprint.

.4 Advise Contract Administrator of any changes to proposed method of dewatering at least two (2) weeks before enacting change.

.5 Upon completion of dewatering installations, submit a detailed plan of the dewatering system as constructed including test data and computations demonstrating that the system is capable of achieving the desired result.

1.6 Power Supply

.1 Provide all power and connections as required. Obtain power from construction power supply as specified in Division 1.

.2 Construction power supply as specified in Division 1 is interruptible.

.3 All power on Site is backed up by the site generator.

1.7 Design Criteria

.1 Design dewatering scheme to maintain the groundwater level at least 1000 mm below the underside of excavation required for all pipelines or structures under construction.

.2 Discharge dewatering system in accordance with Environmental Guidelines.

.3 Discharge piping to be designed to allow for discharge redirection as directed by Contract Administrator, without affecting dewatering operations. Route piping to maintain unrestricted access to plant operations and other construction activities.

.4 Provide tap at point of dewatering discharge for sampling purposes.

2. PRODUCTS (NOT USED)

3. EXECUTION

3.1 General

.1 Prior to commencement, survey and monitor adjacent structures.

.2 Level of groundwater beneath excavation must be measured by the installed piezometers.

3.2 Dewatering

.1 Control groundwater in a manner that will preserve the strength of the foundation soils, will not cause instability of the excavation slopes, and will minimize damage to existing structures.

.2 Lower the water table in advance of excavation using wells, well points, or similar methods.

.3 Maintain the water level, as measured in piezometers, a minimum of 1000 mm below the prevailing excavation level for structure or pipeline under construction, unless otherwise noted.

.4 Dewatering must be managed to accommodate variations in groundwater levels resulting from tides, river levels, precipitation and other influences to prevent flooding of excavations.

.5 Insulate or otherwise protect dewatering pipes and equipment from freezing.

.6 Keep excavations free of water at all times while work is in progress.

.7 Protect open excavations against flooding and protect side slopes from damage due to surface run-off and piping.

.8 Dispose of water in a manner not detrimental to public or private property, or any portion of Work completed or under construction.

.9 At all times, operate the dewatering system in such a manner as to detect and guard against the danger caused by the possible discharge and accumulation of methane and other potentially explosive gases which may be present in the ground water during dewatering operations.

.10 Prior to terminating any dewatering operations, submit to Contract Administrator means of flotation prevention for constructed structures.

.11 Prevent rapid recharge when terminating dewatering operations to prevent loosening of subbase material.

END OF SECTION

EXCAVATION AND BACKFILL FOR STRUCTURES

1. GENERAL

1.1 Section Includes

.1 Materials, applications, installation and verification for excavating and backfilling for structures.

1.2 Related Sections

.1 Section 33 05 05 – Excavation, Trenching, and Backfilling.

.2 Section 31 50 00 – Excavation Support Systems.

1.3 Shoring, Bracing and Underpinning

.1 Comply with Manitoba Occupational Health and Safety Requirements and applicable local regulations to protect existing features.

.2 Engage services of qualified Professional Engineer, registered in the Province of Manitoba to design and inspect any shoring and bracing required to construct the Work.

.3 At least two (2) weeks prior to commencing Work, submit design and supporting data.

.4 Design and supporting data submitted to bear the stamp and signature of qualified Professional Engineer registered in the Province of Manitoba.

.5 Professional Engineer responsible for design of temporary structures to submit proof of insurance coverage for professional liability except where Engineer is employee of Contractor, in which case Contractor shall submit proof that Work by Professional Engineer is included in Contractor's insurance coverage.

2. PRODUCTS

2.1 Materials

.1 Type 1S: Engineered fill.

.1 Structural fill consisting of low to medium plastic clay (liquid limit <45%), granular material, or native silty sand or sandy silt. Soils to be free of organic content, rocks larger than 75 mm and unfrozen.

.2 Type SS: Free Draining granular fill.

.3 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.1.

Sieve Designation	% Passing		
	Type 1S	Type 2S	Type SS
75 mm	—	100	—
25 mm	100	—	100
19 mm	74-100	—	—
9.5 mm	50-90	—	65-100
4.75 mm	35-75	22-85	50-90
2.00 mm	20-50	—	35-75
0.425 mm	10-25	5-30	10-45
0.180 mm	5-15	—	0-20
0.075 mm	3-13	0-10	0-5

.4 Type 3S: selected material from excavation or other sources, approved by the Contract Administrator for use intended, unfrozen and free from rocks larger than 75 mm, organics, cinders, ashes, sods, refuse or other deleterious materials.

.5 Type 4S: Local or imported clay used for capping excavations shall be free from stones, building debris and organic matter. It shall be of a suitable composition and texture to provide and maintain an impervious cap.

2.2 Quality Control Testing

.1 Moisture density curves to ASTM D698.

.2 Sieve analyses to ASTM C136.

.3 Field densities to ASTM D2167 or to ASTM D6938.

.4 Minimum quality control test frequencies specified as follows are the minimum number required. Testing of materials and compaction shall be carried out by a laboratory approved by City. Contractor shall have testing company perform as many tests as are necessary to ensure that the Work conforms to the requirements of the Contract regardless of the minimum number required.

.5 Provide moisture/density curves for each type of material from each source to be compacted to a specified density.

.6 Field Densities:

.1 One (1) field density for every 100 linear m of 300 mm compacted layers of backfill and embankment.

.2 One (1) field density for every 100 m^2 of 150 mm compacted layers of backfill under slabs.

3. EXECUTION

3.1 Shoring and Bracing and Underpinning

.1 Construct temporary works to depths, heights and locations as approved by the Contract Administrator.

.2 During backfill operation:

.1 Unless otherwise as indicated or as directed by Contract Administrator, remove sheeting and shoring from excavations.

.2 Do not remove bracing until backfilling has reached respective levels of such bracing.

.3 Upon completion of substructure construction:

.1 Remove shoring and bracing.

.2 Remove excess materials from Site and restore watercourses as indicated and as directed by Contract Administrator.

3.2 Dewatering

.1 Keep excavations free of water while Work is in progress, and in accordance with Section 31 23 19 - Dewatering of Excavations.

.2 Protect open excavations against flooding and damage due to surface run-off.

.3 Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut-offs or other means.

3.3 Frost Protection

.1 The bottom of the excavation, backfill and area around shall be protected from frost. Damage resulting from concrete placed on frozen ground or from ground freezing beneath or around footings shall be corrected at no extra cost to the City.

3.4 Excavation

.1 Excavate to lines, grades, elevations and dimensions as required to construct completed structures.

.2 Excavation slopes should be cut no steeper than 1H:1V. Flatter slopes may be required if saturated silt or sand layers are encountered that have not been dewatered adequately in advance. If space does not permit a sloped excavation, shoring will be required.

.3 Do not disturb soil within branch spread of trees or shrubs that are to remain. If excavating through roots, excavate by hand and cut roots with sharp axe or saw.

.4 Dispose of surplus and unsuitable excavated material in approved location off Site.

.5 Do not obstruct flow of surface drainage or natural watercourses.

.6 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter. Protect bottoms of excavations from softening. Should softening occur, remove softened soil and replace with concrete at no additional cost.

.7 Notify Contract Administrator when bottom of excavation is reached.

.8 Obtain Contract Administrator approval of completed excavation.

.9 Remove unsuitable material from trench bottom to extent and depth as directed by Contract Administrator.

.10 Where required due to unauthorized over-excavation, correct as follows:

.1 Fill under bearing surfaces and footings with concrete specified for footings.

.2 Fill under other areas with Type 2S fill compacted to minimum of 98% Standard Proctor Density.

.11 Hand trim, make firm and remove loose material and debris from excavations. Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.

3.5 Fill Types and Compaction

.1 Use fill of types as indicated or specified below. Compaction densities are percentages of maximum densities obtained from ASTM D698.

.1 Engineered fill beneath slab on grade: Type 1S clay fill placed in 150 mm lifts, compacted to 98% SPD.

.2 Exterior side of perimeter walls: Type 3S to sub-grade level except under concrete apron slabs; compact to 92% but no more than 95% in maximum 300 mm lifts. Cap with Type 4S.

.3 The top 600 mm of backfill, under topsoil areas, shall be an impervious clay cap of Type 4S, to maintain moisture in the topsoil.

3.6 Bedding and Surround of Underground Services

.1 Place and compact granular material for bedding and surround of underground services as indicated and as specified elsewhere.

3.7 Backfilling

.1 Do not proceed with backfilling operations until Contract Administrator has inspected and approved installations, including successful completion of hydrostatic test.

.2 Areas to be backfilled are to be free from debris, snow, ice, water and frozen ground.

.3 Do not use backfill material which is frozen or contains ice, snow, or debris.

.4 Place backfill material in uniform layers not exceeding 300 mm compacted-thickness up to grades indicated. Compact each layer before placing succeeding layer.

.5 Backfilling around installations:

.1 Place bedding and surround material as specified elsewhere.

.2 Do not backfill around or over cast-in-place concrete until concrete design strength is achieved.

.3 Place layers simultaneously on both sides of installed work to equalize loading. Difference not to exceed 0.3 m.

.6 Use only hand operated compaction equipment within 1.0 m of foundation walls.

3.8 Restoration

.1 Upon completion of Work, remove surplus materials and debris; trim slopes, and correct defects as directed by Contract Administrator.

.2 Replace topsoil as indicated or directed by Contract Administrator.

.3 Clean and reinstate areas affected by Work as to condition, which existed prior to excavation.

3.9 Inspection and Testing

.1 Testing of materials and compaction may be carried out by laboratory designated by City.

.1 City will pay for costs for inspection and testing.

END OF SECTION

EXCAVATION SUPPORT SYSTEMS

1. GENERAL

1.1 Description

.1 Provide excavation support systems as indicated and in compliance with Contract Documents.

.2 Design, furnish and install excavation support systems to maintain lateral support, prevent loss of ground, limit soil movements to acceptable limits and protect from damage existing and proposed improvements including pipelines, utilities, structures, roadways, ~~railroads~~ and other facilities.

.3 The requirement of specified excavation support systems in areas indicated on the drawings does not relieve the Contractor from the responsibility of furnishing and installing proper temporary excavation support systems in other areas.

.4 Common types of excavation support system include, but are not limited to; singular or multiple stages comprised of cantilevered or internally braced soldier piles and lagging, steel sheetpile wall, timber sheetpile wall, trench box, or combinations thereof. Trench box temporary excavation support system is only acceptable for pipe or utility trench excavations approved by the Contract Administrator. Temporary unsupported open cut excavation with stable sloping sides is allowed where applicable.

.5 Extraction of steel sheetpile wall, timber sheetpile wall, or soldier piles are not permitted unless otherwise indicated, specified or approved by the Contract Administrator.

.6 Wherever the word "sheeting" is used in this Section or on the Contract Drawings, it shall be in reference to any type of excavation support system specified except trench box.

.7 Construction of the excavation support systems shall not disturb the existing structures (such as the primary clarifier 1 and others) or the completed proposed structures. Damage to such structures shall be repaired at Contractor’s expense.

.8 Adjacent structures are those that are bear upon soils above the proposed excavation depth and within a distance equal to twice the total depth of the excavation away from the closest edge of the excavation. Monitor and protect adjacent structures (such as the primary clarifier 1 and others) as specified and indicated.

.9 Vibration monitoring for excavation support systems shall be performed as specified within Section 31 63 19.11.

.10 Bear the entire cost and responsibility of correcting any failure, damages, subsidence, upheaval or cave-ins as a result of improper installation, maintenance or design of the excavation support systems. Pay for all claims, costs and damages that arise as a result of the Work performed at Contractor’s expense.

1.2 References

.1 American Concrete Institute (ACI):

.1 304: Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.

.2 ASTM International (ASTM):

.1 A36: Standard Specification for Structural Steel.

.2 A416: Standard Specification for Strand Steel, Uncoated Seven Wire for Prestressed Concrete.

.3 A572: Standard Specification for High-Strength Low Alloy Columbium-Vanadium Structural Steel.

.4 A615: Standard Specifications for Deformed and Plain Billet Steel Bars for Concrete Reinforcement.

.5 A722: Specification for Uncoated High Strength Steel Bar for Prestressing Concrete.

.3 American Wood-Preserves Association (AWPA) Standards:

.1 P23-10: Standard for Chromated Copper Arsenate Type C (CCA-C).

.2 P50-10: Standard for Fire Retardant FR-2 (FR-2).

.4 American Welding Society (AWS):

.1 D1.1: Structural Welding Code.

.5 Occupational Safety and Health Administration (OSHA) Standards and Regulations contained in Title 29: Subpart P - Excavations, Trenching and Shoring.

1.3 Submittals

.1 Submit the following in accordance with Section 01 33 00 – Submittal Procedures.

.1 Submit the following qualifications four (4) weeks prior to the construction:

.1 Qualifications of Contractor’s excavation support system designer as specified in Paragraph 1.4.6.

.2 Qualifications of Contractor’s excavation support system installer as specified in Paragraph 1.4.7.

.3 Qualifications of Contractor’s independent tieback testing laboratory as specified in Paragraph 1.4.8 if a tieback system is utilized.

.4 Qualifications of Contractor’s excavation support system installation supervisor as specified in Paragraph 1.4.9.

.5 Qualifications of vacuum excavation subcontractor as specified in Paragraph 1.4.5, if DMPs for utilities are utilized.

.2 Submit an excavation support plan stamped and signed by a professional engineer registered in the province of Manitoba at least two (2) weeks prior to start of the construction. Do not submit design calculations. The review will be only for the information of the City and third parties for an overall understanding of the project relating to access, maintenance of existing facilities and proper utilization of the Site. The Contractor remains responsible for the adequacy and safety of the means, methods and sequencing of construction. The plan shall include the following items as a minimum:

.1 Proposed excavation support system(s), details, location, layout, depths, extent of different types of support relative to existing features and the permanent structures to be constructed, and methods and sequence of installation and removal.

.2 Certificate of Design: Refer to Section 01 33 00 – Submittal Procedures.

.3 A list of all design assumptions, including safety factors used for the excavation support system(s) and all lateral pressures used for each system.

.4 If utilizing a tieback system, include tieback installation procedures and criteria for acceptance of tiebacks for performance and proof tests. Submit the tieback testing results to the Contract Administrator for information only.

.5 Requirements of dewatering during the construction.

.6 Minimum lateral distance from the edge of the excavation support system for use for vehicles, construction equipment, and stockpiled construction and excavated materials.

.7 List of equipment used for installing the excavation support systems.

.8 Monitoring schedule, installation procedures and location plans for vibration/noise monitoring, geotechnical instrumentation (deformation monitoring points and inclinometers) and observation wells/piezometers to monitor ground, excavation support system, adjacent structures and groundwater fluctuation during the entire construction period.

.3 Submit a construction contingency plan specifying the methods and procedures to maintain excavation support system stability if the allowable movement of the adjacent ground and adjacent structures is exceeded.

.4 Monitoring data within one (1) day of data collection from vibration and noise recording equipment, observation wells, deformation monitoring points and offset lines. Data shall include:

.1 Horizontal and vertical movements of geotechnical instruments and groundwater readings.

.2 New movements since the initial readings of the geotechnical instruments.

.3 Weekly summary in tabular and graphic form at the end of each week.

.4 A schematic plan of excavation and/or relevant construction activities at the time of monitoring.

.5 For excavation support systems left in place, submit the following as-built information prior to backfilling and covering the excavation support systems:

.1 Survey locations of the excavation support systems, including coordinates of the ends and points of change in direction.

.2 Type of the excavation support system.

.3 Elevations of top and bottom of the excavation support systems left in place.

1.4 Quality Assurance

.1 Provide in accordance with Section 01 45 00.

.2 Conform to the requirements of the OSHA Standards and Interpretations: "Part 1926 Subpart P - Excavation, Trenching, and Shoring".

.3 Retain the services of an independent vibration consulting firm meeting the requirements as specified within Section 31 63 19.11**.**

.4 The peak particle velocity for pile installation, or other vibration-inducing operations, shall meet the requirements as specified in Section 31 63 19.11.

.5 If utilizing deformation monitoring points (DMPs) for utilities, vacuum excavation shall be performed by subcontractor having five (5) years of experience in non-destructive vacuum excavation methods for utilities.

.6 Prepare design, including calculations and drawings, under the direction of a Professional Engineer registered in Manitoba and having the following qualifications:

.1 Not less than ten (10) years experience in the design of specific excavation support systems to be used.

.2 Completed not less than five (5) successful excavation support system projects of equal type, size, and complexity within the last five (5) years.

.7 Excavation Support System Installer's Qualifications:

.1 Not less than three (3) year experience in the installation of similar types and equal complexity as the proposed system.

.2 Completed not less than three (3) successful excavation support systems of similar type and equal complexity as the proposed system.

.8 If utilizing a tieback system, employ an independent testing laboratory to test the tieback system with the following qualifications:

.1 Be accredited by the American Association of State Highway and Transportation Officials (AASHTO) Accreditation Program.

.2 Employ personnel conducting testing who are trained in the methods and procedures to test and monitor tieback systems of similar type and equal complexity, as the proposed system.

.3 Have not less than five (5) years experience in testing of tieback systems of similar type and equal complexity as the proposed system.

.4 Have successfully tested at least three (3) tieback systems of similar type and equal complexity as the proposed system.

.9 Install all excavation support systems under the supervision of a supervisor having the following qualifications:

.1 Not less than five (5) years experience in installation of systems of similar type and equal complexity as the proposed system.

.2 Completed at least five (5) successful excavation support systems of similar type and equal complexity as the proposed system.

.10 All welding shall be performed in accordance with AWS D1.1.

1.5 Design Criteria

.1 Design of excavation support systems shall meet the following minimum requirements:

.1 Support systems shall be designed for earth pressures, hydrostatic pressure, equipment, temporary stockpiles, construction loads, roadways, railroads, and other surcharge loads.

.2 Design a bracing system to provide sufficient reaction to maintain stability.

.3 Limit movement of ground adjacent to the excavation support system to be within the allowable ground deformation as specified.

.4 Design the embedment depth below bottom of excavation to minimize lateral and vertical earth movements and provide bottom stability. Toe of braced temporary excavation support systems shall not be less than 1.5 m (5 feet) below the bottom of the excavation.

.5 Design excavation support systems to withstand an additional 0.60 m (2 feet) of excavation below proposed bottom of excavation without redesign except for the addition of lagging and/or bracing.

.6 Maximum width of pipe trench excavation shall be as indicated on the drawings.

.7 Do not cast permanent structure walls directly against excavation support walls.

.8 The design location of the excavation support wall shall be determined such that the installed wall and bracing system components are all located outside the limits of the permanent structure. Construction tolerances (e.g. wall verticality) shall be considered in determining the plan location.

1.6 Delivery, Storage and Handling

.1 Provide in accordance with Sections 01 61 00 and as specified.

.2 Store sheeting and bracing materials to prevent sagging which would produce permanent deformation. Keep concentrated loads which occur during stacking or lifting below the level which would produce permanent deformation of the material.

2. PRODUCTS

2.1 Materials

.1 Structural Steel: All soldier piles, wales, rakers, struts, wedges, plates, waterstop and accessory steel shapes shall conform to ASTM A36.

.2 Steel Sheet Piling: ASTM A572, continuous interlocking type.

.3 Timber Lagging Left in Place: Pressured treated per AWPA standards.

.4 Tieback Tendons: Tieback tendons shall be high strength steel wire strand cables conforming to ASTM A416, or bars conforming to ASTM A722. Splicing of individual cables shall not be permitted.

.5 Raker Ties: ASTM A615 Grade 60.

.6 Cement Grout Materials And Admixtures For Tieback Anchorages: Grout cube strength shall be a minimum 3500 psi (25 MPa) at 7 days and 5000 psi (35 MPa) at twenty-eight (28) days.

.7 Concrete: Section 03 30 00.

.8 Tamping tools adapted for backfilling voids after removal of the excavation support system.

.9 Provide specific trench box sizes for each pipe and utility excavation with structural capacity of retaining soil types as described in OSHA's 29 CFR Part 1926 Subpart P.

2.2 Equipment

.1 A vibratory hammer shall be utilized for driving the sheet piling providing that such operations do not exceed vibration/noise requirements of the specifications. Impact hammer shall be utilized when vibratory hammer is unable to drive sheet piling to required depth and/or unable to meet vibration requirements. Impact hammer shall also meet noise requirement.

3. EXECUTION

3.1 Installation

.1 Installation of the excavation support systems shall not commence until the related earth excavation and dewatering submittals have been reviewed by the Contract Administrator with all Contract Administrator’s comments satisfactorily addressed.

.2 Install excavation support systems in accordance with the excavation support plan.

.3 If utilizing a tieback system, all performance and proof tests shall be conducted in the presence of the Contract Administrator. Testing performed without the Contract Administrator present is considered invalid. Repeat testing in the Contract Administrator's presence at Contractor's expense.

.4 Do not drive sheeting within 30 m (100 feet) of concrete less than seven (7) days old.

.5 Carry out program of excavation support in such a manner as to prevent undermining or disturbing foundations of existing structures of Work ongoing or previously completed.

.6 Bottom of the trench box excavation support system shall be above the pipe invert prior to installing the pipe.

.7 Install and read geotechnical instrumentation in accordance with the excavation support plan. Notify the Contract Administrator immediately if any geotechnical instrumentation is damaged. Repair or replace damaged geotechnical instrumentation at the sole option of the Contract Administrator and at Contractor's expense.

.8 Continuously monitor movements of the ground adjacent to excavation support systems and adjacent structures. In events of the measured movements approaching or exceeding the allowable movements, take immediate steps to arrest further movement by revising procedures such as providing supplementary bracing, filling voids behind the trench box, supporting utilities or other measures (Construction Contingency Plan).

.9 Notify utility owners if existing utilities interfere with the excavation support system. Modify the existing utility with the utility owner's permission or have the utility owner make the modifications at Contractor's expense.

3.2 Ground Deformation Adjacent to Excavation Support Systems

.1 Allowable Vertical (heave/settlement) and Lateral Movements: 50 mm (2 inches) maximum for the trench box excavation support system, and 25 mm (1 inch) maximum for other types of excavation support systems at any location behind the excavation support system.

.2 Monitoring personnel shall use a procedure for reading and recording geotechnical instrumentation data which compares the current reading to the last reading during data collection to eliminate spurious readings.

.3 Plot the observed ground deformation readings versus time. Annotate the plots with construction loading and excavation events having an impact on the readings. Evaluate plots by means of secondary rate-of-change plots to provide early warning of accelerating ground movements.

.4 Notify the Contract Administrator when the allowable ground deformation is exceeded.

.5 Implement Construction Contingency Plan under direction of the temporary excavation support system designer and the Contract Administrator**.**

3.3 Removal of Excavation Support Systems

.1 Sheeting shall be left in place unless otherwise indicated.

.2 When indicated, remove the excavation support system without endangering the constructed or adjacent structures, utilities, or property. Immediately backfill all voids left or caused by withdrawal of excavation support systems with bank-run gravel, screened gravel or select borrow by tamping with tools specifically adapted for that purpose.

.3 When tiebacks are used, release tension in tiebacks as the excavation is backfilled. Do not leave tensioned tieback in place at the completion of the Work.

.4 The excavation support system left-in-place shall be cut-off a minimum of 0.60 m (2 feet) below the bottom of the next higher foundation level or a minimum of 1.50 m (5 feet) below finished grade.

.5 Conduct survey of the locations and final cut-off elevations of the excavation support systems left in place.

3.4 Contract Closeout

.1 Provide in accordance with Section 01 78 00 – Closeout Submittals.

END OF SECTION

BORED AND SOCKETED CAISSON PILES

1. GENERAL

1.1 Related Sections

.1 Geotechnical investigation report.

.2 Section 03 20 00 - Concrete Reinforcing.

.3 Section 03 30 00 - Cast-In-Place Concrete.

1.2 Work Included

.1 Third Party Vibration Monitoring of existing adjacent buildings.

.2 Pile Capacity and Integrity Testing.

1.3 References

.1 2010 National Building Code and the Manitoba Amendments.

.2 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.3 CAN/CSA-A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005.

.4 ACI 306R, Guide to Cold Weather Concreting.

.5 ASTM C 260/260M, Standard Specification for Air-Entraining Admixtures for Concrete.

.6 ASTM C494/C494M, Standard Specification for Chemical Admixtures for Concrete.

.7 ASTM D1143, Standard Test Methods for Deep Foundation Elements under Static Compressive Load.

.8 ASTM D3689, Standard Test Methods for Deep Foundation Elements under Static Tensile Load.

.9 ASTM D5882, Standard Test Method for Low Strain Impact Integrity Testing of Deep Foundations.

.10 The latest edition of all Reference Standards shall be the latest edition at the time of Contract award.

1.4 Description

.1 This Specification covers all operations relating to the supply and installation of rock-socketed caissons for the building piles including but not limited to overburden drilling, rock coring, water control, rock-socket inspection, supply and installation of steel casings, splicing of steel casings, galvanizing of steel casings, supply and placement of concrete and reinforcing steel, removal of temporary steel casings and disposal of excavated material.

.2 A geotechnical investigation report has been prepared and is bound into the project manual.

.3 Supplying and installation of steel casing tips.

.4 The Work to be done by the Contractor under this Section shall include the furnishing of all superintendence, overhead, labour, materials, equipment, tools, supplies and all things necessary for and incidental to the satisfactory performance and completion of all Work as hereinafter specified.

1.5 Definitions

.1 Overburden: All material encountered above the bedrock including imported fill and native soils.

.2 Weathered Rock Zone: Weathered rock encountered above the sound bedrock including voids and soil filled cavities which would require permanent steel casing to support the caisson hole.

.3 Sound Rock: Rock which may contain fractures but a casing is not required to support the caisson hole.

1.6 Provisional Pay Items

.1 Base Tender Price on a length basis per linear metre of caissons shown on the Drawings including all labour and material required to install rock-socketed caissons to Elevations as per Contract Drawings.

.2 The actual quantities required might vary from the estimated quantities. The same unit price shall be applicable regardless of actual quantities required.

1.7 Elevations on Drawings

.1 The caisson elevations shown on the Drawings are approximate only. Refer to the test hole logs and all other available information to gain more knowledge about the surface and subsurface conditions.

1.8 Submittals

.1 The Contractor shall submit to the Contract Administrator for review and approval, at least ten (10) Business Days prior to the commencement of any tremie concrete operations the proposed tremie concrete procedures.

1.9 Quality Control

.1 Perform the work by a Piling Subcontractor with minimum twenty (20) years of proven, satisfactory and successful piling experience on projects of similar size and nature.

.2 The Contractor shall be fully responsible for quality control of all aspects of the piling works.

.3 Submit and implement a Quality Control Plan a minimum of four (4) weeks prior to first scheduled piling; the Quality Control Plan shall include:

.1 Identify the Quality Control Manager.

.2 Qualifications of construction supervisory personnel.

.3 Third party vibration monitoring personnel and qualifications.

.4 Pre-placement procedures, and checklists.

.5 During placement contingency plans and procedures.

.6 Post-placement procedures and checklists for concrete.

.7 Vibration Monitoring Plan.

.8 Pile Installation Plan.

.4 Submit for review by the Contract Administrator copies of pile records.

1.10 Inspection and Testing

.1 Inspection and Vibration Monitoring of Existing Structures:

.1 The Contractor shall supply and operate enough suitable seismographs to accommodate the vibration monitoring for all structures located within the influenced zone, during pile installation. The Contractor shall monitor vibrations at structures within the 65 m radius of influence identified by the Contract Administrator, for the duration of the pile installation activities. The vibration monitoring equipment shall be capable of recording and reporting peak particle velocity (range of 2.5 to 250 mm/second) and frequency of vibration (range of 2 to 400 Hz in three axes) simultaneously for all structures within the specified radius.

.2 The seismograph equipment shall be made available for inspection and the data able to be downloaded by or provided to the Contract Administrator at any time during the pile installation activities.

.3 The City of Winnipeg shall arrange and complete structural inspections of nearby structures to the site, to the extent the City of Winnipeg will permit, prior to the start of and upon completion of pile installation. The City of Winnipeg shall document the existing conditions with sufficient photographs and produce one site inspection report that covers all structures prior to start of pile installation, and the condition after the pile installation is complete, and make the report available to the Contractor.

.4 The Contractor shall take all precautions to prevent damage to structures and adjacent properties during or as a consequence of pile installation operations. In the event of damage, the Contractor will be held liable, and shall be required to provide appropriate restoration and repairs at his cost, to the satisfaction of the Contract Administrator.

.5 Qualifications of Vibration Monitoring Personnel:

.1 The Contractor's vibration-monitoring personnel shall have the qualifications specified herein. These personnel may be on the staff of the Contractor or may be on the staff of a specialist subcontractor, However, they shall not be employed nor compensated by subcontractors, or by persons or entities hired by subcontractors, who will provide other services or material for the project.

.2 The Contractor's vibration-monitoring personnel shall include a qualified Vibration Instrumentation Engineer (Contractor's Vibration Engineer) who is a registered Professional Engineer in the Province of Manitoba, who has a minimum of a Bachelor of Science degree in civil engineering, and who has at least four (4) years of experience in the installation and use of vibration-monitoring instrumentation and in interpreting instrumentation data. The Contractor's Vibration Engineer shall:

.1 Be on site and supervise the initial installation of each vibration-monitoring instrument.

.2 Supervise interpretation of the vibration-monitoring data.

.6 Vibration Monitoring Plan shall include:

.1 The name of the Firm or Company providing the vibration monitoring services, including vibration monitoring staff qualifications.

.2 Description of the instrumentation, and equipment to be used.

.3 Vibration monitoring equipment laboratory calibration and test equipment certification.

.4 Measurement locations and methods for mounting the vibration sensors.

.5 Procedures for data collection and analysis.

.6 Means and methods of providing warning when the Response Values as specified in the Data Interpretation and Implementing Plans of Action section of this Special Provision are reached.

.7 Generalized plan of action to be implemented in the event any Response Value as specified in in the Data Interpretation and Implementing Plans of Action section of this Section is reached. The generalized plan of action shall be positive measures by the Contractor to control vibrations (e.g. using alternative construction methods).

.8 Submit data and reports as specified in Data Reduction, Processing, Plotting and Reporting section of this specification section.

.7 Pile Installation Plan:

.1 The Contractor shall develop a pile installation plan identifying the equipment to be used to install the piles, the sequence of pile installation, the maximum anticipated vibrations from the pile installation and a defined trigger level. The Contractor shall hire a Geotechnical Engineer (Contractor’s Geotechnical Engineer) registered in Manitoba to review the pile installation plan and estimate the maximum anticipated vibrations during construction. Pile installation plan should include a proposed action and response plans in case a defined trigger level is exceeded. The Contractor's Geotechnical Engineer shall submit the signed and sealed pile installation plan for review by the Contract Administrator.

.2 The maximum allowable vibration threshold during construction shall be 7.6 mm/second (0.3 inches/second) as per Canadian Highway Bridge Design Code

(CAN/CSA-S6-06) latest edition. If at any time during pile installation the vibrations exceed this threshold, the Contractor shall cease pile installation operations, revise and resubmit the pile installation plan to reduce the vibrations below the identified threshold.

2. PRODUCTS

2.1 General

.1 The Contractor shall be responsible for the supply, safe storage and handling of all materials set forth in this Specification. All materials supplied under this Specification shall be subject to inspection and acceptance by the Contract Administrator.

2.2 Handling and Storage

.1 Storage of materials shall be in accordance with CSA Standard CAN/CSA A23.1. Materials damaged by careless or negligent handling or storage by the Contractor shall be replaced at the Contractor's expense.

2.3 Testing

.1 All materials supplied under this Specification shall be subject to inspection by the Contract Administrator and testing by the Testing Laboratory designated by the Contract Administrator. There shall be no charge to the City for any materials taken by the Contract Administrator for testing purposes.

.2 All materials shall be approved by the Contract Administrator at least twenty-one (21) days before any construction is undertaken. If, in the opinion of the Contract Administrator, such materials, in whole or in part, do not conform to the Specification detailed herein or are found to be defective in manufacture or have become damaged in transit, storage or handling operations, then such material shall be rejected by the Contract Administrator and replaced by the Contractor at their own expense.

2.4 Steel Casings

.1 Steel casings shall be as follows:

.1 Provide minimum 19 mm thick temporary casing conforming to the requirements of ASTM A252 Grade 3.

.2 When mill test certificates originate from a mill outside of Canada or the United States of America, the Contractor shall have the information on the mill test certificate tested and verified by independent testing by a Canadian laboratory. This laboratory shall be certified by an organization accredited by the Standards Council of Canada to comply with the requirements of OSO/IEC 17025 for the specific tests or types of tests required by the material standard specified on the mill test certificate.

.3 Splicing of the steel casings shall be with full penetration welds. Welding, welder qualifications, pre-qualification of weld details and inspection of the welds shall conform to the requirements of the AASHTO/AWS Bridge Welding Code D1.5 and CSA W59 (latest editions).

.2 Galvanizing shall be in accordance with ASTM A123/A123M to a minimum net retention of 610° g/m^2 to the limits identified herein and on the Drawings and painted with polyurethane paint to match concrete color to the requirements of the Specification E66.

.3 Steel Casing Tips:

.1 The Contractor shall supply and install outside fit, open-end cutting shoe for the caissons such as Versa-Steel 200 Series, or equivalent as approved by Contract Administrator in accordance with B7.

.2 The Contractor shall submit to the Contract Administrator for review and approval, connection details and weld procedures for the pipe pile open-end cutting shoe in accordance with the details shown on the Drawings. Applicable welding procedures shall be stamped as approved by the Canadian Welding Bureau.

2.5 Concrete

.1 Mix concrete in accordance with section 03 30 00 - Cast-In-Place concrete to achieve design strengths and mixes as indicated on Structural Drawings.

.2 The concrete shall be placed by the tremie method.

2.6 Reinforcing Steel

.1 The reinforcing steel as specified in section 03 20 00 - Concrete Reinforcing.

2.7 Equipment

.1 All equipment shall be of a type accepted by the Contract Administrator and shall be kept in good working order.

.2 Tremie Equipment:

.1 The tremie pipe shall consist of a tube, having a diameter of not less than 250 mm, constructed with sections having flange couplings fitted with gaskets. The discharge end shall have a proper seal so that water will not enter the tube at any time.

3. EXECUTION

3.1 Examination

.1 Before starting piling, examine other Work that may affect this Work.

.2 Notify the Contract Administration of any conditions that would prejudice proper installation of this Work.

.3 Carry out structural inspection of the existing structure prior to installation of piles and report assessment to the Contract Administrator.

3.2 Installation

.1 The Contractor shall lake all precautions to prevent damage to structures and adjacent properties during or as a consequence of pile installation operations. In the event of damage, the Contractor will be held liable, and shall be required to provide appropriate restoration and repairs at his cost, to the satisfaction of the Contract Administrator.

.2 Vibration Monitoring of Existing Structures:

.1 The purpose of the vibration monitoring program is to help protect nearby properties from excess vibration during pile installation activities associated with the pile installation work for all structures within 65 m (straight-line distance) from the pile installation activities.

.2 The Contractor shall supply and operate enough suitable seismographs to accommodate the vibration monitoring for all structures located within the influenced zone, during pile installation. The Contractor shall monitor vibrations at structures within the 65 m radius of influence identified by the Contract Administrator, for the duration of the pile installation activities The vibration monitoring equipment shall be capable of recording and reporting peak particle velocity (range of 2.5 to 250 mm/second) and frequency of vibration (range of 2 to 400 Hz in three axes) simultaneously for all structures within the specified radius.

.3 The Contractor shall install seismographs near the closest exterior comer of each structure that is within the specified radius range of the pile installation activities.

.4 The seismograph vibration sensors shall be located at points on the ground between 1 and 2 m from the structure facades unless otherwise directed by the Contract Administrator.

.5 The seismograph vibration sensors shall be firmly mounted on a surface slab of concrete or asphalt or firmly set in undisturbed soil.

.6 The seismograph equipment shall be made available for inspection and the data able to be downloaded by or provided to Contract Administrator at any time during the pile installation.

.3 Installation of Seismographs:

.1 The Contractor's instrumentation personnel shall conduct regular maintenance of seismograph installations.

.2 All seismographs shall have been calibrated by the manufacturer or certified calibration laboratory within one year of their use on site. A current certificate of calibration shall be submitted to the Contract Administrator with the Contractor's data.

.4 Vibration Monitoring of Existing Structures Data Collection:

.1 The Contractor shall collect seismograph data prior to any vibration-producing pile installation activities to document background vibrations at each monitoring location. This monitoring shall consist of a continuous recording of the maximum single-component peak particle velocities for one-minute intervals, which shall be stored in the device memory or printed on a strip chart. The background monitoring shall be performed for a

minimum of two (2) non-consecutive workdays, spanning the hours during which pile installation activities will take place.

.2 The Contractor shall monitor vibration during pile installation construction activities as determined by the Contract Administrator. This monitoring shall consist of a continuous recording of the maximum single-component peak particle velocities for one-minute intervals, which shall be stored in the device memory or printed on a strip chart. During the monitoring, the Contractor shall document all events that are responsible for the measured vibration levels, and submit the documentation to the Contract Administrator with the data as specified in the Data Reduction, Processing, Plotting and Reporting section of this Special Provision.

.3 All vibration monitoring data shall be recorded contemporaneously and plotted continuously on a graph by the data acquisition equipment, Each graph shall show time-domain wave traces (particle velocity versus lime) for each transducer with the same vertical and horizontal axes scale.

.4 The Contractor shall notify the Contract Administrator at least twenty-four (24) hours prior to starting new pile-installation tasks, and shall have the seismographs in place and functioning properly prior to any such activity within 65 m of the monitoring locations. No significant pile installation activity shall occur within this zone unless the monitoring equipment is functioning properly.

.5 The equipment shall be set up in a manner such that an immediate warning is given when the peak particle velocity in any direction exceeds the Response Values specified in the Data Interpretation and Implementing Plans of Action section of this Special Provision. The warning emitted by the vibration-monitoring equipment shall be instantaneously transmitted to the responsible person designated by the Contractor, by means of warning lights, audible sounds or electronic transmission. The Contractor shall then immediately notify the Contract Administrator regarding the exceedance warning.

.5 Vibration Monitoring of Existing Structures Data Reduction, Processing, Plotting and Reporting:

.1 Raw data shall be made available to the Contract Administrator on a daily basis.

.2 Within ten (10) Business Days after the completion of the background vibration monitoring, the Contractor shall submit to the Contract Administrator a hard copy report documenting the results at each of the monitoring locations,

.3 During pile installation, activities, the Contractor shall provide weekly, hard copy reports summarizing any vibration monitoring data collected at the specified vibration-monitoring locations. The reports for each week shall be submitted on or before the end of the following week.

.4 All reports shall be signed by the approved Vibration instrumentation Contract Administrator, and shall include the following:

.1 Project identification, including Project Name and assigned Structure address as shown on the project plans.

.2 Location of the monitoring equipment, including address of adjacent building(s).

.3 Location of vibration sources (e.g. pile installation equipment, etc.)

.4 Summary tables indicating the date, time and magnitude and frequency of maximum single-component peak particle velocity measured during each one-hour interval of the monitoring period.

.5 Field data forms (pile installation vibration monitoring),

.6 Appendix graphs of the strip charts (if any) printed during the monitoring periods.

.7 In addition to the hard copy data specified herein, the Contractor shall provide data on 120 mm-diameter computer diskettes (CDs) with each report. Electronic data files for all instrument data shall be provided in dBASE IV (DBF) format.

.6 Vibration Monitoring of Existing Structures Damage to Instrumentation:

.1 The Contractor shall protect all instruments and appurtenant fixtures, leads, connections, and other components of vibration-monitoring systems from damage due to construction operations, weather, traffic, and vandalism.

.2 If an instrument is damaged or inoperative, the Contractors instrumentation personnel shall repair or replace the damaged or inoperative instrument within seventy-two (72) hours at no additional cost. The Contractor shall notify the Contract Administrator at least twenty-four (24) hours prior to repairing or replacing a damaged or inoperative instrument. The Contract Administrator will be the sole judge of whether repair or replacement is required.

.7 Vibration Monitoring of Existing Structures Disclosure of Data:

.1 The Contractor shall not disclose any instrumentation data to third parties and shall not publish data without prior written consent of the City.

.8 Vibration Monitoring of Existing Structures Data Interpretation and Implementing Plans of Action:

.1 The Contractor shall interpret the data collected, including making correlations between seismograph data and specific pile installation activities. The data shall be evaluated to determine whether the measured vibrations can be reasonably attributed to pile installation activities.

.2 The Response Values for vibration include a trigger value of 6.3 mm per second (0.25 inches per second) and a Limiting Value of 7.6 mm per second (0.3 inches per second). The actions associated with these Response Values are defined below. Plans for such actions are referred to herein as Plans of Action, and actual actions to be implemented are referred to herein as Response Actions. Response Values are subject to adjustment by the Contract Administrator as indicated by prevailing conditions or circumstances.

.1 If a trigger Value is reached, the Contractor shall:

.1 Immediately notify the Contract Administrator.

.2 Meet with the Contract Administrator to discuss the need for Response Action(s).

.3 If directed by the Contract Administrator during the above meeting that a Response Action is needed, submit within twenty-four (24) hours a detailed specific plan of action based as appropriate on the generalized Plan of Action submitted previously as part of the Vibration Monitoring Plan specified in the Submittals section of this Special Provision.

4. CONSTRUCTION METHODS

4.1 Location and Alignment of Caissons

.1 The Caissons shall be installed in the positions shown on the Drawings or as directed by the Contract Administrator. The Contractor will be required to remove obstructions in order to achieve the proper alignment.

.2 Alignment shall not deviate more than two percent (2%) of caisson length out of plumb and not more than 75 mm off centre at the top of caisson.

4.2 Cut-off of Steel Casings

.1 The casings shall be set to the elevations shown on the Drawings.

.2 All costs associated with the casing cut-offs shall be incidental to the Work.

4.3 Rock-Socketed Caisson Installation

.1 The Contractor shall install shaft holes and temporary steel casings to diameters indicated on the Drawings at each caisson location. The steel casings shall be advanced into bedrock to the depth indicated on the Drawings or as determined by the Contract Administrator.

.2 The Contractor may determine that permanent steel casings are required in addition to the temporary casings shown on the Drawings.

.3 The Contractor shall install rock sockets using core barrels to diameters indicated on the Drawings. The sockets shall be advanced into sound bedrock to the depth indicated on the Drawings or as determined by the Contract Administrator. Ensure loose material is removed and the caisson is free of foreign material. Any water or material removed from the caisson holes shall be collected and removed from site and properly disposed of at Contractor's own expense.

.4 The inspection shall consist of the following. Inspection shall be performed in each rock socket with the Contract Administrator and Contractor present. The inspection shall be capable of showing all vertical and bottom faces of the rock socket. If, following the inspection by an approved method, in the opinion of the Contract Administrator the rock socket for any given caisson has not penetrated a continuous section of sound bedrock of the depth and quality suitable for rock socket installation, the Contractor will be required to extend the length of the socket until this condition is satisfied or as directed by the Contract Administrator.

.5 If the rock socket is found to have loose material or foreign matter inside, the material shall be removed by the Contractor to the satisfaction of the Contract Administrator. Additional

inspections will be required following cleaning operations or further drilling of the rock sockets as directed by the Contract Administrator.

.6 The Contractor shall maintain accurate records of the bedrock strata elevation, tip elevations, casing depth, and socket length for each caisson. At the completion of these works, three (3) copies are to be submitted to the Contract Administrator.

.7 The Contract Administrator may require extension of the steel casings into bedrock and extension of the rock sockets if, in the opinion of the Contract Administrator, it is necessary in order to reach an acceptable quality of sound bedrock. The Contract Administrator may also reduce the length of rock sockets at the time of installation based on the quality of rock as determined by the Contract Administrator.

.8 Upon acceptance of the caisson hole by the Contract Administrator the Contractor shall place the reinforcing steel as indicated on the Drawings and fill the entire length of the caissons with tremie concrete to the top of caisson elevation.

.9 Supply, installation and removal of temporary steel casings if required for installation of caissons are incidental to the Work.

4.4 Cleaning the Base of the caisson Shaft and Downhole Video Monitoring

.1 The Contractor shall construct rock sockets for piles using core barrels to diameters indicated on the Drawings. The sockets shall be advanced into sound bedrock to the depth indicated on the Drawings or as determined by the Contract Administrator. Core barrel should be used to retrieve the rock cores in-order to be inspected by the Contract Administrator to assess the competency of the bedrock.

.2 Upon final excavation, and prior to pouring the concrete, the entire shaft base shall be cleaned, all loose or sediment materials shall be removed and the base of the caisson shall be free of foreign material. An air lift pump or any other effective method of cleaning shall be used and moved around the base of the excavation to ensure the base of the shaft is cleaned effectively and to the satisfaction of the Contract Administrator. Any water or material removed from the caisson holes shall be collected and removed from the site and properly disposed of at Contractor’s own expense.

.3 Following the excavation of the rock sockets to the required depth, the Contractor is required to provide evidence to the Contract Administrator that the socket is in an acceptable condition. A remote television inspection with video link to the surface or other similar inspection means will be required to demonstrate that the specified condition of the completed sockets have been met, and/or to the satisfaction of the Contract Administrator.

.4 All costs associated with televised inspection at each rock socket location shall be incidental to the Work.

4.5 Tremie Concrete Procedure

.1 Where tremie concrete is to be used, sufficient additional cement shall be added to the mix to compensate for dilution due to the depositing of concrete in the water.

.2 Tremie concrete shall be deposited in a manner accepted by the Contract Administrator. Tremie concrete shall not be placed without the Contract Administrator's approval. The tremie pipe outlet shall be kept at least 1.0 m below the concrete surface at all pour stages.

.3 To prevent segregation, concrete deposited underwater shall be carefully deposited in a compact mass in its final position by means of a tremie pipe, or other approved method, and shall not be disturbed after being deposited. Still water shall be maintained at the point of deposit. The water level shall be regulated so that there is no fluctuation of water pressure that may be injurious to the concrete.

.4 The minimum rate of depositing tremie concrete shall be 15 m^3/hr. Continuous soundings shall be taken during the concrete pour and all irregularities in the concrete profile shall be corrected. If a tremie pipe is used, it shall be supported so as to permit:

.1 free movement of the discharge end over the entire top surface of the Work; and

.2 rapid lowering when necessary to retard or stop the flow of concrete.

.5 The discharge end shall be closed at the start of the Work in order to prevent water from entering the tube and it shall be sealed at all times when not within the deposited concrete.

.6 The tremie tube shall be kept full up to the bottom of the hopper. When a batch is dumped into the hopper, the flow of concrete shall be induced by slightly raising the discharge end, always keeping it within the deposited concrete.

.7 In the event of the groundwater level being higher than the pile head cut-off level shown in the contract drawings, the Contractor shall submit his proposal for agreement prior to placing concrete. The pile head shall not be let below the groundwater level unless adequate and agreed precautions are taken.

.8 Where tremie concrete is used, in addition to the heating and hoarding requirements per Section 03 30 00 – Cast-In-Place Concrete, the Contractor shall heat the water inside the caisson shaft to a minimum temperature of 5°C, and shall maintain the water above the deposited concrete at this temperature for a period of at least seven (7) days.

4.6 Heating and Hoarding

.1 The Contractor shall make provisions for heating the concrete, in accordance with Section 03 30 00. All costs associated with heating and hoarding shall be incidental to the Contract Unit Price for "Supply and Install Rock-Socketed Caissons".

5. PILE CAPACITY TESTING AND REPORTING

5.1 Static Load Testing

.1 One static compressive pile load test shall be carried out to confirm the geotechnical pile design parameters used in the design prior to installation of piles on site.

.2 Static Load testing shall be completed by an independent testing agency specializing in this type of Work. The independent testing firm shall be engaged by the Contractor and supply and install all testing equipment and analyze the test results in accordance with this

specification. The Contractor shall be responsible to coordinate and manage all associated static load testing activities.

.3 Static load testing and reporting shall be completed in accordance with ASTM D1143 for piles subjected to axial loads and ASTM D3689 for piles subjected to axial tensile loads and as outlined in the Contract Documents. As a minimum, the report shall include the following:

.1 Site plan showing locations of test pile and nearest test holes;

.2 Test hole logs and summary of subsurface conditions;

.3 Type and dimensions of test and anchor piles;

.4 Test pile material including basic specifications;

.5 Pile installation details;

.6 Final pile top and tip elevations;

.7 Ground surface elevation;

.8 Date and type of load test;

.9 Temperature and weather conditions during the test;

.10 Description of instrumentation used to monitor pile performance during testing including their locations;

.11 Description of test setup and testing procedures;

.12 Tabulation of time, load, and displacement readings;

.13 Interpretation and analyses of test results including failure load and the criterion used to estimate it, shaft friction, and end bearing resistance (as applicable);

.14 Pile load-movement curve; and

.15 Pile time-load and time-movement curves.

.4 The static load test report shall be submitted to the Contract Administrator for review and acceptance within seven (7) days of completion of testing.

.5 The Contractor shall submit details of all proposed testing measures and pile testing procedures in his piling plan two (2) weeks prior to commencement of construction. Contract Administrator, at his sole discretion, will accept or reject the Contractor's substitution proposal.

6. INTEGRITY TESTING OF PILES

6.1 General

.1 Piles shall be selected by the Contract Administrator for testing and detection of major faults, necking, bulging, voids, Honeycombing, discontinuities, and cross-sectional areas of the piles.

Integrity testing of piles shall be carried out by an independent testing organization approved by the Contract Administrator.

.2 If the results of the tests show that the pile or piles are defective, the pile or piles shall be treated as faulty and shall be rejected unless the Contractor can demonstrate to the approval of the Contract Administrator effective remedial measures that will be carried out.

.3 The results of tests shall be printed out immediately during test with printer facility at the site and submit to Contract Administrator at site. The Contract Administrator's interpretations and conclusions arrived at on the test results shall be final.

.4 Working piles shall be subjected to shock method.

6.2 Sonic Echo and/or Impulse Response (Shock Test) Method

.1 Preparation of the Pile Head:

.1 The pile head shall be clearly exposed, free from debris, etc. and not more than 1.0 m above or below ground level, otherwise the surrounding soil shall be built up or excavated to meet this condition. The pile head shall be smooth over its complete cross-section free from irregularities and perpendicular to the vertical axis of the pile.

.2 The pile head shall consist of sound concrete. This shall be achieved during the concreting of the pile by flushing out all weak mortar, etc. from the top of the pile head and carefully screeding off to provide a smooth level surface in sound concrete. Alternatively, if the pile head is prepared after concreting, all weak mortar, broken concrete, etc. shall be removed from the pile head to expose sound concrete over its complete cross-section. After cleaning it off to ensure a sound bond, a very thin screed (maximum 10 mm) of strong sand/cement mortar, rapid hardening compound, shall be spread to provide a smooth working surface for the shock test equipment. The mortar shall be allowed to harden before testing.

.3 Any reinforcement or any other inclusions protruding from the pile head shall not prevent the testing team from giving the pile the required impact force over the centre of the pile and the placing of a 50 mm diameter (approx.) electronic pick up at about 100 mm from the periphery of the pile. Access shall be provided for the service van within 30 m of the pile.

.2 Shock Test Equipment:

.1 The shock which is to be imparted onto the pile head shall be carried out using an impulse hammer or any approved method which is capable of transmitting vibration to the base of the pile shaft and a motion sensor (either a geophone or an accelerometer). The electronic pick-ups located on the pile head shall be approved velocity transducers or accelerometers connected through an approved frequency analyzer to a X-Y plotter. The mechanical admittance shall be plotted on a vertical scale and the frequency on the horizontal scale. Both the horizontal and vertical scales and the frequency on the horizontal scale. Both the horizontal and vertical scales shall be varied as required. The equipment shall have an independent power supply.

.3 Shock Test:

.1 The Contractor shall provide the qualified and experienced testing team with a site plan showing the pile layout and a list of the piles to be tested. Ten (10) piles shall be tested as selected by the Contract Administrator.

.2 Before testing, the heads of the piles shall be inspected by testing team for regularity and soundness and any unsatisfactory pile heads shall be reported to the Contract Administrator. They shall be made good to the satisfaction of the Contract Administrator and smoothed off using a suitable epoxy mortar if necessary. Preliminary tests shall be carried out to establish the appropriate scales and to check the electronic circuit.

7. MEASUREMENT AND PAYMENT

7.1 Supply and Install Rock-Socketed Caissons

.1 Refer to Measurement and Payment Section 01 40 00.

7.2 Steel Casing Tips

.1 Refer to Measurement and Payment Section 01 40 00.

END OF SECTION

1. GENERAL

1.1 Scope of Work

.1 This Section outlines the requirements for earthworks related to pavement and sidewalk construction. This includes excavation of organic and saturated materials, placement of suitable site and imported fill in pavement sub-grade and boulevard areas, backfilling of existing ditch areas within the limits of the construction area and excavation required for placement of base and sub-base materials for new pavement structures.

1.2 Measurement and Payment

.1 Excavation of existing material from ditch or pavement areas will be measured and paid for in accordance with City of Winnipeg Standard Construction Specification CW 3170 for Excavation.

.2 Sub-grade Compaction will be measured and paid for in accordance with City of Winnipeg Standard Construction Specification CW 3110.

.3 Placement and compaction of fill material in general areas and ditches will be measured and paid for in accordance with City of Winnipeg Standard Construction Specification CW 3170 for Suitable Site Fill Material and Imported Fill Material.

2. PRODUCTS

2.1 Fill Material:

.1 Suitable Site Material to be as per City of Winnipeg Standard Construction Specification CW 3170.

.2 Imported Fill Material to be as per City of Winnipeg Standard Construction Specification CW 3170.

3. EXECUTION

3.1 General

.1 Do not perform work during inclement weather conditions or under adverse field conditions such as frozen ground or ground covered with snow, ice, or standing water.

3.2 General and Ditch Excavation

.1 Remove all standing water from existing ditch bottoms or general areas requiring excavation.

.2 All vegetation and topsoil shall be removed from ditches or general areas. The sideslopes of existing ditches are to be cut to approximately 4H:1V or flatter to provide a transition zone between the in-situ and fill material.

.3 Prior to placement of fill material the sub-grade shall be benched in order to key in the fill material to the in-situ material. The bench dimensions shall be as determined in the field by

the Contract Administrator. Benching shall be considered incidental to excavation and no further payment shall be made.

.4 The base of all areas to be filled shall be proof rolled in the presence of the Contract Administrator, prior to backfilling, to confirm that the sub-grade is undisturbed, competent, has been adequately cleaned of ponded water, disturbed, loosened, saturated, softened, organic and other deleterious material. Remedial work shall be carried out as directed by the Contract Administrator. Proof rolling shall be considered incidental to the placement of fill material in ditches and general fill areas and no additional payment shall be made.

.5 Excavation for placement of pavement base materials, outside ditch areas, to be completed in accordance with City of Winnipeg Standard Construction Specification CW 3170.

3.3 Placement of Fill Material

.1 Fill material in sub-grade, boulevard and ditch areas shall be placed in 300 mm maximum depth loose lifts at or near to optimum water content and compacted to a minimum of 95% of its Standard Proctor density to the elevation of bottom of the sub-base material for pavement areas or topsoil for boulevard areas.

3.4 Sub-grade Compaction

.1 The Contractor shall compact the sub-grade in areas of new pavement construction where excavation is required to place sub-base and base course material. Sub-grade Compaction will be completed in accordance with CW 3110.

3.5 Restoration of Access Ramp Areas

.1 Where fill is placed against existing materials, use stair-like benches with raise and step of same length to bond and key-into the existing fill. Raise and step length shall be a minimum of 0.3 m with a maximum height of step not to exceed 1 metre .

.2 Works to be completed in accordance with CW 3170 Earthwork and Grading.

.3 Scarify the top 75 mm of the previous lift before placing the next layer.

.4 Rework or remove and replace defective fill placed at densities lower than the specified density or at moisture contents outside the specified acceptable range of moisture content or otherwise not conforming to the requirements of the Contract Documents.

END OF SECTION

SUB-BASE MATERIAL

1. GENERAL

1.1 Scope of Work

.1 This Section outlines the requirements for the placement and compaction of sub-base course material for the construction of the new roadways and parking areas.

1.2 Measurement and Payment

.1 Placement and compaction of sub-base course material will be measured and paid for in accordance with City of Winnipeg Standard Construction Specification CW 3110 for Crushed Sub-Base Material, 50 mm Limestone.

2. PRODUCTS

2.1 Sub-Base Material

.1 Sub-base Material to be as per City of Winnipeg Standard Construction Specification CW 3110 for Crushed Sub-base Material, 50 mm Limestone.

3. EXECUTION

3.1 General

.1 Do not perform work during inclement weather conditions or under adverse field conditions such as frozen ground or ground covered with snow, ice, or standing water.

.2 Placement and Compaction of Base Material:

.1 Complete placement and compaction of sub-base material in accordance with City of Winnipeg Standard Construction Specification CW 3110.

END OF SECTION

BASE MATERIAL

1. GENERAL

1.1 Scope of Work

.1 This Section outlines the requirements for the placement and compaction of base course material for the construction of the new roadways and parking areas.

1.2 Measurement and Payment

.1 Placement and compaction of Base course material will be measured and paid for in accordance with City of Winnipeg Standard Construction Specification CW 3110.

2. PRODUCTS

2.1 Base Course Material

.1 Base Course Material to be as per City of Winnipeg Standard Construction Specification CW 3110 for Crushed Limestone.

3. EXECUTION

3.1 General

.1 Do not perform Work during inclement weather conditions or under adverse field conditions such as frozen ground or ground covered with snow, ice, or standing water.

3.2 Placement and Compaction of Base Material

.1 Complete placement and compaction of base material in accordance with City of Winnipeg Standard Construction Specification CW 3110.

END OF SECTION

ASPHALTIC CONCRETE PAVING

1. GENERAL

1.1 Scope of Work

.1 This Section outlines the requirements for the placement of the asphaltic concrete for pavements and overlays for the construction of new roadways and new parking areas.

1.2 Measurement and Payment

.1 Construction of asphaltic concrete pavement and overlays will be paid for in accordance with City of Winnipeg Standard Construction Specification CW 3410.

2. PRODUCTS

2.1 Asphaltic Concrete Pavement

.1 Asphaltic Concrete to be supplied as per City of Winnipeg Standard Construction Specification CW 3410, for Type 1A Asphalt.

3. EXECUTION

3.1 General

.1 Do not perform work during inclement weather conditions or under adverse field conditions such as frozen ground or ground covered with snow, ice, or standing water.

3.2 Placement of Asphaltic Concrete Pavement

.1 Complete placement of asphaltic concrete pavement and overlays in accordance with City of Winnipeg Standard Construction Specification CW 3410.

.2 The Contractor will be required to place two lifts of 50 mm asphalt concrete on the Westerly Aqueduct Bridge, however only one final lift of 50 mm is required on the Middle and Easterly Aqueduct Bridges as indicated on the Drawings.

.3 When paving over the Westerly Aqueduct Bridge the application of tack coat onto the protection board is required. The asphalt paving machine shall proceed in the same direction as the protection board. The Contractor shall saw-cut the asphalt, supply and place an approved joint sealant as shown on the Drawings.

.4 The finished surface of each lift of bituminous pavement shall be smooth, free from segregation and roller marks, uniform and true to line and cross-section as shown on the Plans or as specified by the Contract Administrator.

.5 Finished top lift pavement, on which the surface is defective in texture, uniformity or riding quality, shall be correct at the expense of the Contractor if so directed by the Contract Administrator. Correction shall be as outlined in Table 1 below.

Table 1: Bituminous Pavement

Defect Criteria	Rejection level	Type of Repair
Bituminous Mix Properties	Outside the following Ranges VMA 14 – 16% In place air voids 3.5 – 5%	Remove and replace
Segregation Minor to severe	As per definition >10% 100 m of one lane pavement	Remove and replace - Final lift only
Surface Defects		
	Areas containing excess or insufficient asphalt	Remove and replace
	Improper matching of longitudinal and transverse joints on final lift of asphalt concrete	Remove and replace joint
	Roller marks on final lift of asphalt concrete	Remove and replace
	Cracking or tearing	Remove and replace
	Contamination by diesel, hydraulic fluids, detergent or other harmful product	Remove and replace
	Foreign objects or materials that are detrimental to the asphalt concrete; and Clay balls or oversized materials	Remove and replace
Density	< 95% of Marshall density	Remove and replace

END OF SECTION

PORTLAND CEMENT CONCRETE PAVING

1. GENERAL

1.1 Scope of Work

.1 This Section outlines the requirements for the construction of the new Portland cement concrete pavement for new roadways.

1.2 Measurement and Payment

.1 Construction of Portland concrete pavement will be paid for in accordance with City of Winnipeg Standard Construction Specification CW 3310 for the applicable thickness and type of pavement constructed.

.2 Installation of drilled dowels and tie bars will be paid for in accordance with City of Winnipeg Standard Construction Specification CW 3230 for the applicable diameter and type of dowel or tie bar installed.

2. PRODUCTS

2.1 Portland Cement Concrete

.1 Portland Cement Concrete to be as per City of Winnipeg Standard Construction Specification CW 3310.

2.2 Reinforcing Steel

.1 Reinforcing steel to be as per City of Winnipeg Standard Construction Specification CW 3310.

2.3 Drilled Dowels and Tie Bars

.1 Drilled Dowels and Tie Bars to be as per City of Winnipeg Standard Construction Specification CW 3230.

2.4 Dowell Assemblies

.1 Dowell Assemblies to be as per City of Winnipeg Standard Construction Specification CW 3310.

3. EXECUTION

3.1 General

.1 Do not perform work during inclement weather conditions or under adverse field conditions such as frozen ground or ground covered with snow, ice, or standing water.

3.2 Portland Cement Concrete Pavement

.1 Complete placement of Portland cement concrete pavement in accordance with City of Winnipeg Standard Construction Specification CW 3310.

3.3 Joint Cleaning

.1 Following the completion of step cutting and prior to sealing the vertical faces of all transverse expansion joints and longitudinal construction joints shall be thoroughly cleaned by sand blasting or be means of an abrasive rotary wheel or brush.

3.4 Joint Sealing

.1 Complete sealing of all joints in Portland cement concrete pavement in accordance with City of Winnipeg Standard Construction Specification CW 3310.

END OF SECTION

CONCRETE WALKS, CURBS, AND GUTTERS

1. GENERAL

1.1 Scope of Work

.1 This Section outlines the requirements for the construction of the new Portland cement concrete sidewalks, curb and curb and gutter for the new roadway and parking areas.

1.2 Measurement and Payment

.1 Construction of concrete curb, curb and gutter and gutter will be paid for in accordance with City of Winnipeg Standard Construction Specification CW 3310.

.2 Construction of concrete sidewalk will be measured on an area basis and will be paid for in accordance with City of Winnipeg Standard Construction Specification CW 3310. The total area of concrete sidewalk paid for will be the total number of square metres of sidewalk constructed in accordance with this specification as accepted and measured by the Contract Administrator.

2. PRODUCTS

2.1 Portland Cement Concrete

.1 Portland Cement Concrete to be as per City of Winnipeg Standard Construction Specification CW 3310.

2.2 Reinforcing Steel

.1 Reinforcing steel to be as per City of Winnipeg Standard Construction Specification CW 3310.

2.3 Drilled Tie Bars

.1 Drilled Tie Bars to be as per City of Winnipeg Standard Construction Specification CW 3230.

3. EXECUTION

3.1 General

.1 Do not perform work during inclement weather conditions or under adverse field conditions such as frozen ground or ground covered with snow, ice, or standing water.

3.2 Construction of Concrete Sidewalk, Curb and Curb and Gutter

.1 Complete construction of concrete curb and curb and gutter in accordance with City of Winnipeg Standard Construction Specification CW 3310.

.2 Where full width concrete sidewalk is to be constructed up to the back of curb the Contractor shall install 200 mm long 10M deformed bars into the back of curb at 600 mm on centre. The Contractor shall ensure that adequate cover is maintained between the end of the bars and the face of curb to prevent spalling of the curb face at the bars. Installation of the 10 M deformed bars shall be considered incidental to the installation of the curb and no further measurement or payment shall be made.

.3 Complete construction of concrete sidewalk in accordance with City of Winnipeg Standard Construction Specification CW 3325.

.4 At the locations indicated on the Drawings the Contractor shall construct the gutter portion only of proposed curb and gutter. This shall be accomplished by either producing a mould which meets the standard details for concrete curb and gutter, minus the curb section, or by constructing curb and gutter and striking off the curb section.

END OF SECTION

EXCAVATION, TRENCHING, AND BACKFILLING

1. GENERAL

1.1 Description

.1 This Section provides the requirements associated with the excavation, trenching and backfilling for utilities.

1.2 References

.1 The following Specifications of the City of Winnipeg Standard Construction Specifications - latest edition are applicable to the Work:

.1 CW 2030 Excavation, Bedding and Backfill.

.2 Division 3 Standard Details – Underground Works:

.1 SD-001 Standard Pipe Bedding Classes.

.2 SD-002 Standard Trench and Excavation Backfill Classes.

.3 SD-003 Jetting Nozzle Insertion Locations.

.3 Division 3 Approved Products for Underground Works.

2. PRODUCTS

2.1 Materials

.1 Products shall be as specified in CW 2030.

3. EXECUTION

3.1 General

.1 Protection:

.1 Before starting Work, locate all utilities serving the Site. Notify all agencies or companies having jurisdiction over the specific utilities and protect, relocate, remove, or discontinue service according to their requirements. Any damages shall be repaired at the Contractor's expense.

.2 Protect and restore pavements, boulevards, grassed areas, etc., that may be opened or damaged in the performance of the Work.

.3 During construction, and at the completion of the Contract, all roads used to haul materials shall be cleaned of materials dropped on them.

.2 Do excavation, trenching, and backfill to CW 2030.

.3 Except as specifically noted on the construction drawings, backfill requirements are as follows:

.1 Beneath, or within 1 m of all existing and proposed pavements, structures or rail sub-grades: Class 2 Backfill.

.2 Within boulevard areas, except as noted above: Class 4 Backfill.

.3 Where trenchless installation is specified, backfill shafts with the class of backfill noted on the construction drawings.

.4 Stockpile material to be used for backfilling on Site as directed by the Contract Administrator. Excess material is to be stockpiled at a location on site as directed by the Contract Administrator.

END OF SECTION

LAND DRAINAGE SEWER

1. GENERAL

1.1 Work Included

.1 The Work included in this Section generally includes, but is not limited to the following items:

.1 Construction of new land drainage sewers, manholes and catchbasins by open trench and trenchless methods.

.2 Connections to the existing land drainage sewers.

.3 Video inspection of new land drainage sewers.

1.2 References

.1 The following specifications of the City of Winnipeg Standard Construction Specifications latest edition are applicable to the Work:

.1 CW 2030 Excavating, Bedding, and Backfill.

.2 CW 2130 Gravity Sewers.

.3 CW 2145 Sewer and Manhole Inspections.

.4 CW 2160 Concrete Underground Structures and Works.

.5 Division 3 Standard Details – Underground Works:

.1 SD-001 Standard Pipe Bedding Classes.

.2 SD-002 Standard Trench and Excavation Backfill Classes.

.3 SD-003 Jetting Nozzle Insertion Locations.

.4 SD-010 Standard Precast Concrete Manhole (for Up to 525 Diameter Pipe).

.5 SD-011 Standard Precast Concrete Manhole (for 600 to 1500 diameter pipe).

.6 SD-020 Nine Arm Mandrel and Proving Ring for 5.25% Deflection Testing of SDR 35 PVC Pipe.

.7 SD-023 Curb and Gutter Inlet with Catch Pit.

.8 SD-024 Catchbasin with Curb and Gutter Inlet.

.9 SD-025 Standard Catchbasin.

.6 Division 3 Approved Products for Underground Works.

2. PRODUCTS

2.1 Materials

.1 Use only those products listed as Approved Products for Underground Use in the City of Winnipeg in the City of Winnipeg Standard Construction Specification, or as noted herein.

.2 Flexible couplings at connections to structures shall conform to City of Winnipeg Standard AT-4.1.1.65.

3. EXECUTION

3.1 Excavation, Bedding and Backfill

.1 Do excavation, bedding and backfill to CW 2030.

.2 Pipe bedding shall be Class B compacted sand bedding except as follows:

.1 Bedding and initial backfill for multiple pipes in common trench shall be Type 2 material as specified in Table CW 2030.1.

3.2 Installation

.1 Installation to CW 2130.

.2 Maintain all sewer flows at all times during installation.

3.3 Testing

.1 Perform sewer and manhole inspections in accordance with CW 2145.

END OF SECTION

MANHOLES AND CATCHBASINS

1. GENERAL

1.1 Scope of Work

.1 This Section outlines the requirements for the Supply and Installation manholes.

1.2 Measurement and Payment

.1 Supply and Installation of manholes will be paid for in accordance with City of Winnipeg Standard Construction Specification CW 2130.

2. PRODUCTS

2.1 Manhole

.1 Manhole to be supplied as per City of Winnipeg Standard Construction Specification CW 2130.

3. EXECUTION

3.1 General

.1 Do not perform Work during inclement weather conditions or under adverse field conditions such as frozen ground or ground covered with snow, ice, or standing water.

3.2 Installation of Manhole

.1 Complete placement of manhole in accordance with CW 2130.

END OF SECTION

ADJUSTMENT OF EXISTING MANHOLE / CATCHBASIN

1. GENERAL

1.1 Scope of Work

.1 This Section outlines the requirements for the adjustment of existing manhole/catchbasin frames and valve boxes within the construction area.

1.2 Measurement and Payment

.1 Adjustment of Manhole/Catchbasin Frames will be measured and paid for in accordance with City of Winnipeg Standard Construction Specification CW 3210. Payment items shall be Adjustment of Manhole/Catchbasin Frames, Cast-in-Place, and Precast.

.2 Adjustment of Valve Boxes will be measured and paid for in accordance with City of Winnipeg Standard Construction Specification CW 3210. Payment items shall be Adjustment of Valve Boxes.

2. PRODUCTS (NOT USED)

3. EXECUTION

3.1 General

.1 Do not perform work during inclement weather conditions or under adverse field conditions such as frozen ground or ground covered with snow, ice, or standing water.

3.2 Adjustment of Existing Manhole/Catchbasin Frames

.1 Adjustment of existing manhole/catchbasin frames will be completed in accordance with City of Winnipeg Standard Construction Specification CW 3210.

.2 Should the elevation of the manhole/catchbasin frame require raising or lowering, the manhole barrel shall be adjusted in such a manner so as to match the type of construction of the barrel. If precast, additional precast riser rings shall be added or removed, if cast-in-place the additional barrel height shall be constructed from cast-in-place concrete or the barrel height shall be cut down. This work shall be considered incidental to the adjustment of the manhole/catchbasin frame and no separate measurement or payment will be made.

3.3 Adjustment of Existing Valve Boxes

.1 Adjustment of existing valve boxes will be completed in accordance with City of Winnipeg Standard Construction Specification CW 3210.

END OF SECTION

PRESSURE PIPELINE

1. GENERAL

1.1 Description

.1 The Work described shall consist of the construction of buried pressure pipelines between the exiting facilities and the new scum dewatering building including the supply and installation of pipe, appurtenances, as well as accessories such as couplings; the hydrostatic testing, and disinfection and bacteriological testing of the pipes used to convey potable water.

1.2 Definition

.1 Abbreviations used in the Detailed Piping Specification Sheets.

Abbreviation	Commodity	Pipe Material
FSW (W3)	Flushing Water	Interior - See Section 40 05 13.01 HDPE DR 17- exterior
HW	Drain	See Section 23 21 13.02
SCP	Scum	Interior - See Section 40 05 13.01 HDPE DR17 - exterior
PD	Process Drain	Interior - See Section 40 05 13.01 HDPE DR17 exterior
PW	Potable Water	HDPE Series 160

1.3 Related Work

.1 Section 03 30 00 - Cast-in-Place Concrete.

.2 Section 31 23 33 - Excavation, Trenching and Backfilling.

1.4 References

.1 City of Winnipeg Standard Construction Specifications:

.1 CW 2110 Watermains.

.2 CW 2125 Flushing, Hydrostatic Leakage Testing and Disinfection of Watermains and Water Services.

.3 Standard Details – Underground Works.

.2 American Society of Mechanical Engineers (ASME):

.1 B16.1: Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.

.3 American Society of Testing and Materials (ASTM):

.1 A53/A53M: Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

.2 D638: Standard Test Method for Tensile Properties of Plastics.

.3 F-714: Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.

.4 D 3350 Specification for Polyethylene Plastics Pipe and Fittings Materials.

.5 F 1055 Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.

.6 D 3035 Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.

.7 F 2620 Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings.

.8 F1962 Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings.

.9 ASTM F 2164 Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure.

.4 American Water Works Association (AWWA):

.1 C509: Resilient-Seated Gate Valves for Water Supply Service.

.2 C550: Protective Interior Coatings for Valves and Hydrants.

.3 C900: Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100mm Through 1500 mm).

.4 C906: Polyethylene (PE) Pressure Pipe and Fittings, 4 in. (100 mm) Through 63 in. (1600 mm), for Water Distribution and Transmission.

.5 Plastic Pipe Institute:

.1 TR-3 Policies and Procedures for Developing Hydrostatic Design Basis (HDB), Hydrostatic Design Stresses (HDS), Pressure Design Basis (PDB), Strength Design Basis (SDB), and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe.

.2 TR-4 PPI Listing of Hydrostatic Design Basis (HDB), Hydrostatic Design Stress (HDS), Strength Design Basis (SDB), Pressure Design Basis (PDB) and Minimum Required Strength (MRS) Ratings For Thermoplastic Piping Materials or Pipe.

.6 CGSB:

.1 CGSB 41-GP-25M-77, Pipe, PE, for the Transport of Liquids.

.7 CSA:

.1 CSA B137.1, PE Pipe, Tubing, and Fittings for Cold-Water Pressure Services.

.2 CSA B137.3, Rigid Polyvinylchloride (PVC) Pipe and Fittings for Pressure Applications.

1.5 Definitions

.1 Appurtenances: Additional piping items as required to provide a complete piping system suitable to convey water as specified and intended. These items may or may not be specified, but are necessary to complete the piping system.

1.6 Submittals

.1 Submit Shop Drawings in accordance with 01 33 00 – Submittal Procedures.

.1 Submittals to include as a minimum the following:

.1 Pipe materials.

.2 Pipe fittings.

.3 Pipe couplings.

.4 Pipe thrust restraint.

.5 Accessories.

.6 Appurtenances.

.2 Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

.3 Instructions: Provide manufacturer's installation instructions for:

.1 HDPE pipe and fittings:

.1 Manufacturer's written bulletins on required procedures, heat and pressures for butt fusion of HDPE Pipe.

.2 Installation requirements for electrofusion fittings.

.4 Field Weld and Fusing Reports:

.1 Submit data on all fusion welds performed. Data shall include:

.1 Location of weld.

.2 Ambient temperature.

.3 Fusion temperature.

.4 Interface pressure.

.5 Heating time.

.6 Cooling time.

.2 Submit data on all electrofusion welds performed.

1.7 Quality Assurance

.1 Materials used for waterlines lines shall be UL listed.

.2 NSF Approval: Material used in the manufacture of HDPE pipe and fittings shall be approved by the National Sanitation Foundation (NSF) for conveying potable water. Pipe and fittings shall bear the NSF label.

2. PRODUCTS

2.1 Pipe

.1 High Density Polyethylene Pipe:

.1 Use DR 17 for all pressure piping unless otherwise stated. Pipe shall be rated for use at a pressure class of 1.37 MPa (200 psi). Piping to be supplied by the roll to allow for a continuous length between the facilities from building connection to building connection except where elbows are specified/required.

.2 To be iron pipe sized, certified for potable water use, made in accordance with CSA B137.1.

.3 NSF 61 certified.

.4 Pipe to be made from polyethylene resin compound with a minimum cell classification of PE 445574C for PE 4710 materials in accordance with ASTM D3350. Material to have a Long Term Hydrostatic Strength of 11 MPa when tested and analyzed by ASTM D2837. Resin to have a minimum hydrostatic design stress of 1000 psi @73 F and shall be a Plastic Pipe Institute (PPI) TR 4 listed compound.

.5 Minimum carbon black shall not be less than 2% when determined in accordance with ASTM D1603 as per CSA B137.1, 4.2 and 5.2.

.6 Shall contain no recycled material except that generated in the Manufacturer's own plant from the resin of the same specification and same raw material supplier.

.7 Compounds used shall meet the requirements of clause 7.2 of CSA B137.0 for toxicity for potable water service.

.8 Manufacture pipe to ASTM F 714.

.9 Markings: continuously or at 1.5 m intervals indent print the following: pipe Manufacturer, nominal pipe size, dimension ratio, PE grade per ASTM D3350, followed by the Hydrostatic Design basis in 100’s of psi, CSA/Warnock Hersey/or NSF International certification complete with certification trademark logo, Manufacturing reference standard ASTM D 3035, and date of manufacture.

.10 Maximum pipe ovality for polyethylene pipe prior to joining shall not exceed 4%.

.2 Fittings:

.1 To be iron pipe sized, certified for potable water use, made in same manner and materials as pipe. Fittings to have same certification as piping. Polyethylene to polyethylene joints to be as per the following:

.1 Joints to be electrofusion couplings. High Density Polyethylene Electrofusion Appurtenances shall be manufactured in compliance with ASTM F-1055 standard for electrofusion type polyethylene fittings for controlled outside diameter polyethylene pipe and tubing. Fittings shall be tested in compliance with ASTM D-2513 and ASTM F-1055. Resin shall be PE 3608 or PE 4710 virgin material that complies with ASTM D-1248 and ASTM D-3350. The fittings shall comply with NSF Standard 61 Plastic Pipe Institute (PPI) rating. Electrofusion fittings shall be rated for a maximum operating pressure of 1135 kPa. Fittings shall be manufactured with an integral identification resistor that automatically sets the fusion time on the electrofusion processor.

.2 All elbows to be long sweep radius.

.3 HDPE Pipe Flange Connections:

.1 Backup rings and Connections to fittings and valves shall utilize fusion bonded epoxy coated ductile iron to AWWA C213 or ASTM A351CF8M (316) stainless steel backing rings. Bolts, Nuts: To be 304 or better stainless steel bolts, nuts and washers on all couplers or materials which are to be buried or submerged. Provide "certification" to the Contract Administrator that materials used for bolts, nuts and washers are stainless steel 304 or better. Flange connections must be approved by the Contract Administrator for the specific application.

.4 Mechanical Couplings:

.1 Couplings required to join two (2) different types of pipe shall be of type compatible with the pipes being used and installed in accordance with the manufacturer's recommendations and shall be subject to the approval of the Contract Administrator.

.2 Coupling to provide full restraint of connections.

.3 Metal body-type couplings with epoxy coating used to make transition connections shall be suitable for 1000 kPa service.

.4 Nuts, bolts and washers shall be all stainless steel with plastic thread protector caps.

.5 Use stainless steel inserts for connections to HDPE piping.

.6 Use George Fischer Waga Multi /joint 3000 Plus series (restraint model) or approved equal.

2.2 Potable Water Pipe (PW)

.1 Use O.D. Tubing sized series 160 HDPE potable water Polyethylene CSA certified and factory marked (i.e. CSA logo) CSA B137.1.

.2 Fittings for water tubing - waterworks brass as manufactured by Mueller or Ford. Outlets compression type. Use stainless steel inserts for poly tubing. Provide manufacturer's recommendations on connection to polyethylene tubing.

3. EXECUTION

3.1 Preparation

.1 Clean pipes, fittings, valves, hydrants and appurtenances of accumulated debris and water before installation. Carefully inspect materials for defects. Remove defective materials from site.

3.2 Fusing

.1 Utilize electrofusion couplings and fittings as recommended by the pipe manufacturer or approved by the Contract Administrator.

.2 During cold or inclement weather, provide adequate shelter over the pipe joining equipment while fusing for protection from the elements (i.e. cold, rain, or wind, etc.).

3.3 Trenching and Backfill

.1 Do trenching and backfill work to Section 31 23 33.

.2 Sand bedding shall be used with all trenched installations.

3.4 Depth of Burial

.1 The pipe shall be laid to the grade and alignment as indicated on the drawings. If no specific grades are given or shown on the Plans, the pipe shall be laid at such a depth below the ground surface that the pipe is provided with an earth cover of no less than 2.75 m above the top of the pipe.

3.5 Pipe Bedding and Initial Backfill

.1 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth as directed by Contract Administrator.

.2 Shape bed true to grade to provide continuous uniform bearing surface for pipe exterior.

.3 Shape transverse depressions in bedding as required to make joints.

.4 Compact for full width of trench and ensure pipe is uniformly supported throughout its length.

.5 Ensure sufficient cover on pipe to permit backfilling without damage being caused to pipe or initial backfill.

3.6 Joints

.1 Piping to be laid in a continuous length from the roll with joints only at locations where elbows are specified/required. Pipes shall be joined to each other by means of electrofusion fittings in accordance with the manufacturer's recommendations.

3.7 Hydrostatic Testing

.1 The Construction Contractor shall perform hydrostatic tests on all portions of the completed pipe under the direct supervision of the Contract Administrator. The length of pipe to be tested shall not exceed the distance between neighbouring valves, except where neighbouring valves are less than 150 m apart or where approved otherwise by Contract Administrator.

.2 All equipment and labour necessary to perform the hydrostatic testing, including water for testing, shall be supplied by the Construction Contractor at his own expense. The equipment shall include all required hoses, pumps, water, make-up tanks and gauges. The Contractor shall utilize test gauges with a minimum ½ % accuracy; minimum 100 mm dial face with increments maximum of 7 kPa (1psi) and calibrated with an upper scale no more than 350 kPa above test pressure. The Contract Administrator shall have the right to use his own gauge and to calibrate the Contractor's equipment.

.3 Hydrostatic testing shall not commence until at least seventy-two (72) hours after the installation of the last thrust block on the line to be tested.

.4 Prior to hydrostatic testing, the line(s) shall be filled slowly with water (which shall be potable in the case of water pipelines) and all air shall be expelled from the line. If permanent air vents, flushouts are not located at all high points, the Construction Contractor shall install main (corporation) stops at such points in order to allow the air to be expelled as the pipe fills with water. The Contractor to use an approved residential water meter to measure how much water is being pumped into the watermain.

.5 For PE Pipe Only:

.1 The line shall be tested for leakage. Unless otherwise specified in Specifications, the test pressure shall be tested at 1.0 MPa. The pipe shall be pressurized until a minimum of twenty-four (24) hours has passed since the line was filled with water. The line shall be pressurized at the test pressure, and over a four (4) hour period, at hourly intervals sufficient make-up water shall be added to return the line to the test pressure, in order to compensate for pipe expansion while under pressure. At the end of this four (4) hour period, the pressure shall be brought up to the test pressure, and over a period not exceeding two (2) hours, the amount of make-up water required to bring the line back up to the test pressure shall be measured. The amount must not exceed the allowable amount given in the following table. If the amount exceeds the allowable, a minimum of eight (8) hours shall be allowed to pass before the procedure may recommence. Leakage shall be found and corrected, until the pipe passes the test.

Allowable Limit or Make-up Water- PE Pipe 2 Hours Test	
Nominal Pipe Size (mm)	**Litres per km of Pipe**
50	9.8
75	14
100	23.3

3.8 Disinfection

.1 Disinfect and test potable water lines in accordance with City of Winnipeg Standard Construction Specifications CW 2125.

.2 Maintain the new piping system isolated from the existing system prior to completion of disinfection and receipt of satisfactory bacterial testing results. Only one connection to the existing system will be permitted for filling and flushing the new mains.

END OF SECTION

DAVIT CRANE

1. GENERAL

1.1 Work Included

.1 Supply testing and commissioning of one (1) portable davit crane complete with manual winch, wire rope and base for removal of submersible pumps.

1.2 Related Sections

.1 Section 43 21 39 – Submersible Pumps.

1.3 Submittals

.1 All submittals to be in accordance with Section 01 33 00 – Submittal Procedures.

2. PRODUCTS

2.1 General

.1 Lift Capacity: Minimum capacity of 50% more than mass of submersible pump.

.2 Minimum hook reach: 1150 mm.

.3 Hook height: 2.3 m.

2.2 Material

.1 Crane Mast, Boom, winch, and Base shall be of Type 316 stainless steel.

.2 Wire rope:

.1 Wire rope construction shall be 7 x 19 (6 mm in diameter) galvanized aircraft cable.

.3 Hook:

.1 Hook shall be of galvanized steel.

2.3 Acceptable Manufacturers

.1 Thern, Commander 2000.

.2 Xylem.

.3 Or Approved Equal.

2.4 Configuration, Components and Features

.1 General:

.1 Provide mounting bases as shown on the Drawings.

.2 Provide one (1) davit crane assembly.

.3 Provide crane assembly with lift capacity to bear the full weight of the heaviest equipment and the mounting base specified on the Drawings, with a safety factor of at least 3.

.2 Mast: Rotate 360 degrees on a pin and sleeve bearing in the base while loaded. Provide handle to the boom for ease of rotation.

.3 Boom:

.1 Provide handle to the boom for ease of rotation.

.2 Adjustable to four (4) different positions, with at least two (2) positions providing the minimum capacity specified in this Section.

.4 Winch: Provide spur gear hand winch with brake for load control.

.5 Davit Floor Base:

.1 Provide Shop Drawings to coordinate davit floor base with davit size.

.2 Davit base shall be supplied as per Section 05 50 00.

.3 Provide side mounted davit bases for submersible mixers in the Bioreactors.

.6 Wire Rope:

.1 Provide wire rope to meet the lift capacity and the vertical lift below floor level specified in this Section.

.2 Provide wire rope keeper at each mounting base for attachment of wire rope when not in use.

.3 Use clevises, safety hooks, or similar attachment fittings with mechanical closures at connection to the boom.

.4 Provide latch type hook and swaged ball fitting.

.7 Fastening Pins:

.1 Crane components shall be fastened together using stainless steel clevis style pins, secured with lynch pins with lanyards fastening the lynch pins to primary structural components.

.8 Winch Location:

.1 Lifting winches shall be located such that the center point of the drive shaft is behind the centerline of the mast.

3. EXECUTION

3.1 Installation

.1 Install and align davit crane in accordance with manufacturer’s recommendations.

3.2 Testing

.1 Factory Tests:

.1 Perform factory tests according to manufacturer's standard test procedures.

.2 Provide certified test results.

3.3 Functional Testing

.1 Implement field quality control measures to facilitate compliant construction and demonstrate compliance with the Contract Documents.

.2 Demonstrate and verify satisfaction of the performance requirements of this Section.

.3 Perform the following tests:

.1 Test by operating the davit crane through a complete lifting and lowering cycle while loaded with the minimum capacity and the safety factor specified in this Section.

END OF SECTION

COMMON WORK RESULTS

1. GENERAL

1.1 Description

.1 This section covers items common to sections of Division 40. This Section supplements the requirements of Division 1.

1.2 Codes and Standards

.1 Complete installation in accordance with latest CSA C22.1 except where specified otherwise.

.2 Comply with all laws, ordinances, rules, regulations, codes, and orders of all Authorities Having Jurisdiction relating to this Work.

1.3 Drawings and Specifications

.1 The intent of the Drawings and Specifications is to include all labour, products, and services necessary for complete Work, tested and ready for operation.

.2 These Specifications and the Drawings and Specifications of all other divisions shall be considered as an integral part of the accompanying Drawings. Any item or subject omitted from either the Specifications or the Drawings but which is mentioned or reasonably specified in and by the others, shall be considered as properly and sufficiently specified and shall be provided.

.3 Provide all minor items and Work not shown or specified but which are reasonably necessary to complete the Work.

1.4 Care, Operation, and Start-up

.1 Instruct City maintenance and operating personnel in the operation, care, and maintenance of systems, system equipment, and components.

.2 Provide these services for such period and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

1.5 Permits, Fees, and Inspection

.1 Submit to Electrical Inspection Department and Supply Authority necessary number of Drawings and Specifications for examination and approval prior to commencement of Work.

.2 Pay associated fees.

.3 Notify the Contract Administrator of changes required by Electrical Inspection Department and Supply Authority prior to making changes.

.4 Furnish a Certificate of Final Inspection and approvals from Electrical Inspection Department and Supply Authority to the Contract Administrator.

1.6 Materials and Equipment

.1 Provide materials and equipment in accordance with Section 01 61 00 - Common Product Requirements.

.2 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department and Supply Authority.

.3 Minimum enclosure type to be used is NEMA 12 unless otherwise specified.

1.7 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 indoor enclosures light grey to ANSI 61 grey enamel, unless otherwise specified.

.2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.3 Clean and prime exposed non-galvanized hangers, racks, and fastenings to prevent rusting.

1.8 Equipment Identification

.1 Identify equipment with nameplates as follows:

.2 Nameplates:

.1 Lamicoid 3 mm thick plastic lamicoid nameplates, white face, black lettering, mechanically attached with self tapping screws.

.3 Wording on nameplates to be approved by the Contract Administrator prior to manufacture.

.4 Allow for average of 25 letters per nameplate.

.5 Identification to be English.

1.9 Wiring Identification

.1 Identify wiring with permanent indelible identifying markings on both ends of all conductors and circuit wiring.

.1 Wire tags to be heat shrink type with black letters on white background.

.2 Wire tags to be legible and visible after the system is installed (i.e. not blocked).

1.10 Submittals

.1 Provide submittals as indicated in the individual Specifications and in accordance with 01 33 00 – Submittal Procedures and 01 78 00 – Closeout Submittals.

1.11 As-Built and Record Drawings

.1 The Contractor shall keep one (1) complete set of white prints at the Site during the Work, including all addenda, change orders, site instructions, clarifications, and revisions for the purpose of recording all changes in the Work. As the Work on-site proceeds, the Contractor shall clearly record in red pencil all as-built conditions, which deviate from the original Contract. As-Built and Record Drawings to include circuiting of all devices, conduit, and feeder runs

(complete with conductor size and number) and locations of all electrical and automation equipment.

1.12 Operation And Maintenance Manuals

.1 Operation and Maintenance Manuals

.1 Refer to Section 01 78 00 – Closeout Submittals for general operation and maintenance manual requirements.

.2 In addition to the general requirements, provide the following information:

.1 Table of Contents – Arrange contents sequentially by systems under Section numbers. Label tabs of dividers between each to match section numbers in the Table of Contents.

.2 Systems Descriptions – A brief synopsis of each system typed and inserted at the beginning of each section. Include sketches and diagrams where appropriate.

.3 Manuals containing all pertinent information, drawings, and documents of the Contractor's supply and/or documentation included with the instruments supplied by others, such as:

.1 Mechanical drawings of the equipment.

.2 Installation drawings and procedures.

.3 Instrument model numbers.

.4 Equipment specifications.

.5 Detailed utility requirements.

.6 Replacement parts list with model numbers.

.7 Recommended preventative maintenance frequency.

.8 Troubleshooting procedures.

.9 Procedures for dismantling.

.10 Procedure to operate the equipment/instruments.

.11 Recommended cleaning procedure.

.12 Recommended list of supplies to be used in conjunction with the operation and maintenance of the equipment.

.13 Recommended spare parts list.

.4 A copy of all wiring diagrams completes with wire coding.

.5 Include type and accuracy of instruments used.

.6 Set of final reviewed Shop Drawings.

.7 Testing documentation including:

.1 Loop check report.

.2 Factory Acceptance Test (FAT) report.

.3 Site Acceptance Test (SAT) report.

.2 PLC Software Operation and Maintenance Manual:

.1 Provide a manual that contains, at minimum, all pertinent information, drawings, and documents associated with the PLC program(s) and associated integration, including:

.1 Printout of the entire PLC program(s). Printout to be sealed by the Contractor's professional engineer.

.2 Repair instructions for common issues.

.3 Printout of any related design documents, such as interface lists, etc.

.4 Flash drive in a sleeve containing the latest PLC program including configuration software.

END OF SECTION

1. GENERAL

1.1 Description

.1 This Section describes the pipe materials, fittings, appurtenances, installation and testing of the process mechanical systems.

.2 This Section is to be read in conjunction with the provided bid information. Provide the design of piping supports, pipe guides and expansion joints. Details and structural attachments shown on the Drawings indicate the level of quality that will be considered acceptable.

.3 The Work will be comprised of a variety of process piping. It is the Construction Contractor's responsibility to assess and evaluate the provided Bid information (e.g. process and instrumentation drawings, process control description) and size and select the appropriate pipe work equipment for each application. The Construction Contractor must provide design justification (i.e. process calculation) for choice.

.4 The Construction Contractor shall provide the necessary submittals and ensure the proper registration of piping systems and system components as required by Authorities Having Jurisdiction, AWWA, API and ASME requirements.

1.2 Definitions and Interpretations

.1 Pressure terms used in this and other related sections are defined as follows:

.1 Operating Limits: The minimum and maximum pressure at which the piping system operates for sustained periods of time.

.2 Test pressure: The hydrostatic pressure used to determine system compliance.

.2 Unless otherwise specified or shown, the interface between piped commodities common to process/mechanical and yard piping is below grade and 0.5 m from the exterior face of a building or tunnel wall unless otherwise shown.

.3 Pipe and appurtenance location terms used in this and other related sections are defined as:

.1 Tunnels, Pumphouse and Buildings: Within an environmentally controlled enclosure where temperature is maintained above 5°C.

.2 Exposed, Aboveground: Outside or within an enclosure which is not environmentally controlled so that the temperature is maintained above 5°C. For the purpose of defining exterior protection systems, this definition is extended to vertical piping to a point of 0.5 m below finished ground level.

.3 Underground (or buried): Placed in soil and not tied to structures.

.4 Below Structures: Below concrete slabs such as tanks, channels, buildings, pipe chases, foundation slabs, etc., but not including roadways or walkway structures.

.5 Submerged: Regularly or occasionally immersed in liquid; inside tanks and/or channels, and within 3.0 m above maximum water level of open tankage. Includes pipe and appurtenances within manholes, vaults and chambers.

1.3 Submittals

.1 Submit documentation listing pipe, fittings, flexible connectors, expansion joints, linings, coatings, and valving to be used for each pipe size and category.

.2 Radiographic Weld Testing: Submit the name and qualifications of at least two (2) independent firms for the radiographic weld testing to be undertaken by the Construction Contractor if and as required by the applicable Code. The selected firm will be subject to the review and acceptance of the Contract Administrator.

.3 A copy of this Specification Section and all referenced sections with each paragraph check marked to show compliance or highlighted to indicate deviation.

.4 Submit copies of all original submittals and all related correspondence made as part of the regulatory submission required by all regulatory authorities.

.5 Product Samples: Where specified or when directed by the Contract Administrator, provide mill test results or product samples.

.6 Provide hanger, guide, anchor, support system design details including locations, load information, design calculations and illustrative drawings, stamped and signed by a Professional Engineer registered in the province of Manitoba.

.7 For expansion joints submit Manufacturer's catalogue data, Shop Drawings and assembly drawings confirming general arrangement, dimensions, tolerances, materials of construction, weights and installation details. Submit calculations to substantiate expansion joint selection and amount of pre-compression, stamped and signed by a Professional Engineer.

.8 Welding: Prior to commencing any welding of stainless steel pipe, prepare and submit to the Contract Administrator a written description of welding techniques including but not limited to materials, methods, and quality control. Identify differences in shop and field techniques. Written procedures will be stamped and sealed by a Professional Engineer and qualified for welding design. For stainless steel welds exposed to process fluids, the weld procedure shall provide for maximizing the corrosion resistance of the final weld as well as providing the mechanical strength required.

.9 Radiographic weld test results.

.10 Prior to the commencement of welding, submit current and complete documentation of the welder's qualifications.

.11 Provide passivation procedures that will be followed.

1.4 Coordination

.1 Process and Utility Piping Identification.

.2 Process and utility piping is identified in the Drawings by a two component alpha-numeric code, (Line Label) as follows:

.1 The first component of the code indicates the nominal line size.

.2 The second component of the code identifies the process fluid being conveyed, (Commodity).

.3 The Commodity codes are defined in the Drawings.

.1 Routing: Coordinate piping installation routes and elevations with installation of sheet metal, process equipment, heating ventilation and air conditioning (HVAC), instrumentation, and electrical work.

.2 Pipe Sleeves: Coordinate with other divisions, prior to construction, to locate and place sleeves in cast-in-place concrete. Also, prior to construction of masonry building elements.

.3 Coordinate with Division 26 to provide correct piping configuration for primary instrumentation elements.

1.5 Quality Assurance

.1 Welding Certification:

.1 All welders to be certified under the AWS or BS Code or Practice and API Pressure Vessels Safety Act and Regulations.

.2 All welders who work on this project shall provide the correct documentation.

.3 Welders working on stainless steel piping shall not work on welding of any other material.

.4 Tools used for stainless steel piping welding shall be new and marked for this use. These tools shall not be used for any other work. Tools shall not be made of materials that could contaminate the stainless steel surface.

.2 Weld Tests:

.1 All piping welds shall be 100% visually inspected by a registered inspector and any imperfections shall be made good as required by the applicable Code and to the satisfaction of the Contract Administrator.

.2 For piping required by the applicable Code to be subject to radiographic inspection, or for welds not found satisfactory during the Contract Administrator 's visual inspection provide for one (1) full circumference radiographic inspection for every twenty (20) welded pipe-to-pipe and pipe-to-fitting joints. All sizes and types of pipe welds to be tested at locations identified by the Contract Administrator.

.3 Have radiographic test firm evaluate welds in accordance with ANSI/ASME B31.3 Process Piping Code Normal Service and prepare report summarizing results.

.4 Have radiographic weld test report, complete with results, submitted directly to Contract Administrator.

.5 For each defective weld, three (3) additional radiographic inspections at locations identified by the Contract Administrator, will be required plus a radiograph of the repair.

.3 Regulatory Submissions:

.1 Complete all other submissions as required by other regulatory authorities.

1.6 Conflicts

.1 Review the Drawings prior to installation of piping, conduit services, and fixtures by this or any other Division. Identify any conflicts and cooperate with the Contract Administrator to determine the adjustments necessary to resolve these conflicts.

.2 Confirm the routing of each section of pipework with other services prior to commencement of installation. Advise the Contract Administrator of any conflicts with existing services or services yet to be installed. Where necessary, amend the routing of pipework to avoid conflict and confirm with the Contract Administrator.

1.7 Shipment, Protection and Storage

.1 Deliver pipe, fittings, and specials to site using loading methods which do not damage pipe or coatings.

.2 Piping materials delivered to site will be clearly marked to indicate size, type, class/schedule and coatings.

.3 Until ready for incorporation in the Works, store on site as recommended by the piping materials manufacturer to prevent damage, undue stresses, or weathering.

.4 Store materials at least 200 mm above ground with sufficient supports to prevent bending.

.5 Protect non-ultraviolet (UV) light inhibited plastic from sunlight.

.6 Ship pipe expansion joints, anchors, guides and flexible connectors pre-assembled to the degree which is practical.

.7 Provide shipping devices to maintain the face-to-face dimension of each expansion joint during shipment, storage and installation. Design and place shipping devices so as not to inhibit installation of the joints.

2. PRODUCTS

2.1 General

.1 Provide the pipe materials, fittings, and appurtenances as described below, for the piping systems shown.

2.2 Pipe Materials General

.1 All pipe materials to be new, free from defects and conforming to the reference standards identified.

.2 Where any standard referenced has been superseded prior to bidding, the Construction Contractor shall comply with the new standard.

2.3 Pipe and Fittings

.1 General:

.1 Provide eccentric reducers in horizontal lines with the flat side on top, unless shown otherwise.

.2 Provide concentric reducers in vertical lines unless indicated otherwise.

.3 Provide long radius elbows unless indicated otherwise. Provide smooth flow stainless steel elbows 350 mm and less, to ANSI B16.9. Provide mitered elbows greater than 350 mm, to AWWA C208 unless otherwise shown or specified. Use three-piece construction unless otherwise shown or specified.

.2 Stainless Steel Pipelines:

.1 Provide stainless steel pipe in accordance with Section 40 23 19.

.2 Less than 75 mm diameter: Provide fittings of the same class as the pipe, conforming to ASTM A403 and ANSI B16.11.

.3 Equal to or greater than 75 mm diameter: Fabricate fittings using similar materials and classes as the pipe and conform to ASTM A774 (scale removed).

.3 PVC Pipe and Fittings:

.1 Schedule 80.

.2 All PVC Schedule 80 pipe shall conform to ASTM D1785, and/or CSA B137.0/B137.3.

.3 PVC Schedule 80 socket fittings shall conform to ASTM D2467 and Schedule 80 threaded fittings shall conform to ASTM D2464.

.4 All potable water pipeline and fittings shall be third party certified to NSF 14.

.5 Provide PVC to CSA B137.3, of the same material and class as the pipe.

.6 Joining to be solvent cementing process. Provide flanges at valves, pumps and equipment only or as indicated and specified.

.7 Provide Type 316 stainless steel flange bolting and hardware for all piping system except sodium hypochlorite use titanium.

.4 Polyethylene Pipelines:

.1 Provide fittings in the same material and class as the pipe.

.2 Thermal butt fusion joints to ASTM D2774.

2.4 Gaskets

.1 For flat faced flanges, use full-face gaskets. For Van Stone, lap joint and raised-face flanges, use full face or ring type gaskets. Conform to ASTM B16.21.

.2 Use gasket materials for flanged connections suitable for the temperature, pressure, and corrosivity of the fluid conveyed in the pipeline durometer.

.3 Unless otherwise specified, minimum gasket material thickness for full face gaskets:

.1 Up to 250 mm pipe diameter; 1.6 mm thick.

.2 Greater than 250 mm pipe diameter; 3.2 mm thick.

.4 Unless otherwise specified, minimum gasket material thickness for raised face ring gaskets:

.1 Up to 100 mm pipe diameter; 1.6 mm thick.

.2 Greater than 100 mm pipe diameter; 3.2 mm thick.

.5 Grooved type gaskets:

.1 Select material as recommended by the Manufacturer for the service conditions indicated.

.2 Unless otherwise specified, provide flush seal type gaskets for all other grooved joint systems.

2.5 Bolts and Nuts

.1 Provide hex head bolts and nuts. Threads to be ANSI B1.20.1, standard coarse thread series.

.2 For general indoor service, use bolts conforming to ASTM A307, Grade A; nuts conforming to ASTM A563, Gr.A.

.3 Provide stainless steel bolts, nuts and washers for exposed, submerged, buried and concrete encased service; bolts conforming to ASTM A193, Gr.B8, C1.1; nuts conforming to ASTM A194, Gr.8. Provide these also for connections above normal water level but which may be subjected to direct contact with splashed water.

.4 Provide hot dip galvanized bolts, nuts and washers for use with hot dip galvanized Van Stone flange back-up rings and lap-joint flange back-up rings.

.5 Provide hex nuts equal to or less than 25 mm. Greater than 25 mm, provide heavy hex.

2.6 Structural Elemental Penetrations

.1 Structural element penetrations are shown and referenced to a detail or Process/Mechanical Standard Details. Where a structural element penetration is not referenced, conform to the Standard Detail relevant to the type of structure, exposure and type of pipe.

.2 Provide pipe sleeves capable of supporting the loads applied during placement of concrete or during blockwork erection. Century Line high density polyethylene (HDPE), SS sleeves with water stop collar may be used where applicable.

.3 Supply wall or floor penetrations into submerged areas, under slab areas, and where shown with a 6 mm thick water stop flange at least 50 mm larger than the pipe or pipe sleeve outside diameter (OD.). Continuously weld the water stop flange, both sides, onto the pipe, connect to flanged sleeve with pipe as per drawing details.

.4 For structural concrete wall and floor penetrations of non-insulated pipe between dry areas, furnish a sleeve which has an internal diameter at least 50 mm larger than the o.d. of the pipe. For pipes 75 mm and less furnish a pipe sleeve 25 mm larger than the o.d. of the pipe. Secure pipe in sleeve with modular pipe seals.

.5 For masonry wall penetrations of non-insulated pipe, furnish a sleeve which has an internal dimension of at least 50 mm larger than the pipe o.d. For pipes 75 mm and less furnish a pipe sleeve 25 mm larger than the o.d. of the pipe. Grout between the sleeve and pipe.

.6 A Standard Detail is shown for segmented modular pipe seals. Where this detail is used for the penetration of a wall separating a dry area from an underground area, tighten the bolts from the inner face and fill the outer annular space with grout. Use stainless steel bolts and nuts in penetrations through walls separating underground or exterior areas from any other area. If seepage occurs during the warranty period, the Construction Contractor is responsible for repair and/or replacement, at no cost to the City. Do not use this type of wall penetration below maximum ground water level elevation.

2.7 Exterior Finishes - (Coatings) Field Applied

.1 Shrink Sleeve:

.1 As an alternative to tape wrap, shrink sleeves are acceptable if material and method of installation is reviewed and accepted by the Contract Administrator prior to use.

2.8 Grout

.1 Non-shrink grout: conform to Non-ferrous grout: pre-mixed, non-shrink, Master Builders 713, Sika M-Bed, CPD Non-Shrink Grout, Steel C1 Grout, minimum 35 MPa compressive strength.

2.9 Concrete

.1 Provide concrete for concrete surround placed around buried pipe, and fill placed over buried pipe, in accordance with Section 03 30 00 and as shown.

3. EXECUTION

3.1 Preparation

.1 Prior to installation, inspect and field measure to ensure that previous work is not prejudicial to the proper installation of piping.

.2 Make all minor modifications to suit installed equipment and structural element locations and elevations.

.3 Advise the Contract Administrator of all modifications. Do not commence work on the related piping until all modifications have been reviewed by the Contract Administrator.

.4 Include any piping modifications in the Shop Drawings submitted prior to fabrication or installation.

3.2 Pipe Handling

.1 Inspect each pipe and fitting prior to installation. Do not install damaged pipe or pipe with damaged protective coatings. Do not use sections of large diameter, thin walled stainless steel piping that may have been deformed out of roundness or dimpled. Such damaged sections shall be discarded.

.2 Remove all foreign matter from inside of pipe prior to installation.

.3 Repair pipe with damaged protective coatings with material similar to the original in accordance with the Manufacturer's directions and to the satisfaction of the Contract Administrator.

.4 Use proper implements, tools, and facilities for the proper protection of the pipe. Exercise care in the installation so as to avoid damage to pipe or coatings.

.5 When lifting sections of large diameter, thin wall piping onto the supports use methods that will prevent damage or deformation. Lift evenly at several places to limit piping deflection between lifting points to a maximum of 6.3 mm.

3.3 Sleeves

.1 Unless otherwise noted or approved by the Contract Administrator, provide sleeves where piping passes through a wall, floor or ceiling.

.2 Locate and place sleeves prior to construction of cast-in-place elements and prior to the construction of concrete and masonry building elements.

3.4 Installation of Pipe Underground/Buried and Below Structures

.1 Trenching and backfill for buried pipe: conform to Division 31.

.2 Pipe laying and bedding: conform to Division 31.

.3 Unless otherwise shown, protect pipe laid below structures with a concrete surround having a minimum coverage of 100 mm all around the pipe; extend concrete surround to undisturbed ground.

.4 For concrete surround, comply with the following:

.1 Install pipe in straight alignment. Do not exceed 10 mm variance from the true alignment in any direction.

.2 Ensure the pipe alignment stays true during and after placement of concrete surround.

.3 Ensure that the method used to prevent pipe uplift during placement of concrete surround results in a level invert and crown.

.4 Maintain pipe circular cross section.

.5 Provide lean concrete to within 150 mm of the underside of the slab or footing for backfill over pipe laid below structures, except as detailed otherwise.

.6 Place concrete in accordance with Section 03 30 00.

.5 Provide Yellow Jacket or tapewrap on all fittings and flanged, grooved, plain end and welded joints underground and below structures.

.6 Unless otherwise specified or shown, for underground piping, provide groove joints or flex coupled joints at 6 m on centre.

.7 Use anti-seize compound with all stainless steel nuts and bolts.

.8 Prior to installation provide a Manufacturer's Representative from the HDPE pipe manufacturer for a minimum of one (1) day to instruct personnel on installation procedures of HDPE pipe.

3.5 Installation

.1 Fabricate and install pressure piping in interior building spaces in accordance with the ASME pressure vessel code. Fabricate and install domestic hot and cold water piping, sanitary piping and storm drainage piping in accordance with Authorities Having Jurisdiction.

.2 Install as per ASME B31.3, latest edition.

.3 Make adequate provision in piping and pipe support systems for expansion, contraction, slope, and anchorage. Supports, bracing, and expansion joints shown in the Drawings are schematic only. The Construction Contractor is responsible for the design, supply, and installation of the piping system in general accordance with the indicated requirements.

.4 Install pipe support system to adequately secure the pipe and to prevent undue vibration, sag or stress.

.5 Install expansion joints where shown and at other locations as necessary to allow for piping expansion and contraction.

.6 Provide temporary supports as necessary during construction to prevent overstressing of equipment, valves or pipe.

.7 Accurately cut all piping for fabrication to field measurements. Process air piping sections shall be measured and cut at 15 to 20°C. If the installation in the field takes place at lower outdoor temperatures, provide circulation of hot air inside the piping to expand the material such that flanges can be bolted. Expansion joints for process air piping shall be blocked at their natural length at 15 to 20°C and such that they will not deflect excessively during handling and installation. These blocks shall be removed prior to pressure testing.

.8 Install pipes in straight alignment. For large diameter (500 ND and greater), thin walled (6.4 mm and thinner) stainless steel piping, laser alignment of all pipe supports. Lateral and vertical misalignment between any three (3) consecutive supports shall not exceed the pipe wall thickness.

.9 For piping other than large-diameter, thin-walled stainless steel, do not exceed 10 mm in 10 m variance from the true alignment, in any direction.

.10 Fabricate and assemble pipe runs so that the pipework is not stressed to achieve the desired alignment and that no stresses are transferred to equipment or equipment flanges. The "springing" of pipework to ensure alignment is not permitted. Undo and subsequently remake all pipework connections to ensure that springing does not occur. Take care not to damage equipment, valves or flanges.

.11 Do not cut or weaken the building structure to facilitate installation.

.12 In parallel pipe runs, offset flanges and/or grooved joint fittings by a minimum of 200 mm.

.13 In vertical pipe runs of diameter greater than 250 mm, provide 200 mm long spool piece on lower side of each valve.

.14 Provide aluminum watertight drip trays under pipe carrying corrosive commodities (sodium hypochlorite, ferric sulphate) crossing over cable trays. The drip trays will be 300 mm wider and 600 mm longer than the piping area over the cable tray. Fit with 12 mm drains that extend to within 150 mm of the floor, near a floor drain.

3.6 Stainless Steel Welding

.1 Conform to reviewed stainless steel pipe welding procedures, which have been stamped and signed by a Professional Engineer registered in the Province of Manitoba.

.2 Remove all scale, rust and any other surface deposits from the entire pipe and fittings before welding. Be particularly thorough with the internal surface preparation.

.3 For all stainless steel pipe intended to convey liquids, use inert gas backing (GMAW or GTAW) for field and shop welds. For these services, solar flux will not be allowed.

.4 Ensure the first bead obtains full root penetration with a minimum of weld material projecting within the pipe.

.5 Grind or buff all welds to a minimum radius of 6mm on all edges and corners to achieve a smooth surface, eliminate any pockets and eliminate any protruding root passes. Adhere to latest edition of NACE RP0178. If material thickness will not allow 6mm radius, make radius one half of material thickness.

.6 Ensure the OD weld (weld cap) is free of excessive weld cap and free of discoloration due to welding. Ensure all ID welds (root pass) or OD welds exposed to corrosive fluids/environments are ground flush and have no discoloration.

.7 Passivation:

.1 Passivate the inside of all stainless steel piping after completion of all piping and supports welding. Any welding after passivation will require passivation of the entire piping section again. A piping section is the length between flanges.

.2 Comply with ASTM A380, Standard Practice for Cleaning, Descaling and Passivation of Stainless Steel Parts, Equipment and Systems, and ASTM A967, Standard

Specification for Chemical Passivation Treatment for Stainless Steel Parts, latest edition.

.3 Use fine-grit carbide sandpaper to remove any discoloration, such as bluish tint due to overheating at welds.

.4 Thoroughly clean the interior of the pipe and ensure there are no oil or grease deposits or particulate (such as from the sandpaper) using trisodium phosphate (TSP) solution per Manufacturer's recommendation. Thoroughly rinse with tap water.

.5 Acid pickle using a solution of 20% nitric acid and 2% hydrofluoric acid in chloride-free water. Treat for no less than two (2) hours at 20°C to 40°C. Do not work at less than 20°C. An equivalent pickling paste shall be used for air piping not designed to be filled with water. Follow the Manufacturer's instructions. Rinse thoroughly with chloride-free water (distilled or de-ionized) until the rinse water shows less than 0.1 mg/L of fluoride. Rinse thoroughly with chloride-free water (distilled or de-ionized) brought to pH 10 using ammonia (preferred). Alternatively caustic soda or soda ash may be used to increase the final rinse water pH, but the maximum concentration of chloride allowed in this solution is 1 mg/L. Note that chloride concentration in commercially available caustic soda and soda ash may be too high for this use. Completely drain and leave drying in warm air (not less than 20°C at the outlet end) overnight.

.6 Collect all acids, caustics and rinses and take all necessary precautions to prevent spills on the ground. Neutralize as needed, for example blending acid and caustic wastes and using pebble or ground limestone, lime or other suitable material. Dispose of the neutralized waste as indicated by the Contract Administrator at the closest primary effluent channel. Note that the Contract Administrator may limit the volume that may be discharged over time.

.7 Process air piping may not be filled with water unless laid flat on the ground or otherwise supported every 5 m and on each side of sliding supports.

.8 Provide adequate ventilation that will blow any fumes away from the worker. This individual shall wear adequate protection per MSDS and clean, thick cloth socks over footwear.

3.7 Grooved Piping System - Installation

.1 All grooved products shall be installed according to Manufacturer's installation instructions.

.2 Schedule 10 and 80 stainless steel pipe shall be roll grooved using "RX" rolls in accordance with Manufacturer's installation instructions.

.3 Copper piping shall be Roll Grooved in accordance with Manufacturer's installation instructions.

3.8 Testing

.1 Give the Contract Administrator twenty-four (24) hours notice prior to testing.

.2 Do not insulate or conceal work until piping systems are tested and accepted.

.3 Complete any required weld tests.

.4 Interior of stainless steel piping shall be bright metal with no discoloration. Any discoloration, such as bluish tint at welds, will require spot pickling and passivation using paste containing nitric acid and hydrofluoric acid, followed by rinsing and drying as indicated previously.

.5 Spot check the interior of the stainless steel piping and weld areas as indicated by the Contract Administrator. Use 5% copper sulphate solution. After ten (10) minutes at not less than 15°C there shall be no observable deposit of metallic copper. Otherwise, pickling and passivation shall be repeated for the entire piping section. Carefully wipe off copper sulphate solution with several damp pieces of cloth.

.6 Supply all water, air and inert gases required for pressure testing.

.7 Supply all pumps, compressors, gauges, etc. required for testing.

.8 Install air threadolets, air relief valves and line fitting valves as necessary to complete testing. Remove after testing and plug the threadolets.

.9 Cap or plug all lines which are normally open ended. Remove on completion of testing.

.10 Provide all temporary thrust restraints necessary for testing. Remove upon completion of testing.

.11 Test all underground lines prior to backfilling. Do not place concrete surround until lines are tested.

.12 Test all existing piping where it connects to new piping to the first valve in the existing piping. Repair any failures in existing piping which occur as a result of the test after informing the Contract Administrator of such failure.

.13 Isolate all low pressure equipment and appurtenances during testing so as not to place any excess pressure on the operating equipment.

.14 Where defective material or equipment is identified, repair or replace using new material.

.15 Release pressure safely, flush and drain liquid pipes after pressure tests. Release pressure safely and purge if needed all gas pipes after pressure tests.

.16 Flush and drain liquid pipes after pressure tests. Purge all gas pipes after pressure tests.

.17 Dispose of flushing water in manner approved by the Contract Administrator, which causes no damage to buildings or siteworks.

3.9 Pressure Testing of Liquid Lines

.1 Hydrostatically test all lines normally used for the conveyance of liquid using water as the test medium.

.2 Test pressures and durations shall be as specified in the detailed specification sheets.

.3 Ensure all lines are filled with water. Bleed air from all high spots using the taps provided specifically for that purpose.

.4 Zero leakage is permitted throughout the specified test period for all exposed piping, buried insulated piping, and any liquid chemical lines.

.5 Show evidence of leakage rates below 0.01 L/hr/mm pipe diameter per 100 m of pipe length for buried piping, unless otherwise specified.

.6 Test drains in accordance with Authorities Having Jurisdiction.

3.10 Pressure Testing of Gas, Air and Vapour Lines

.1 Hydrostatically or pneumatically pressure test, as shown in the table below, all lines normally used for the conveyance of gas, air, and/or vapour in accordance with Process Piping Code B31.3 procedures for testing pressure piping.

.2 For air lines to be hydrostatically tested, check support system to ensure it is capable of withstanding loads imparted by test method. Provide any additional supports necessary in a manner acceptable to the Contract Administrator. At the Contract Administrator's request, provide calculations indicating design of temporary support system.

.3 Other than for sodium hypochlorite and ferric sulphate piping systems, use the following test medium:

Pipe Size Specified	Testing Medium	Test Pressure
50 mm and small	500 kPa or less	Air or Water
50 mm and small	Greater than 500 kPa	Water
Greater than 50 mm	500 kPa or less	Air or Water
Greater than 50 mm	Greater than 500 kPa	Water

.4 Test pressures are identified in the detailed piping specification sheets.

.5 Zero leakage rate for insulated systems, and systems tested with water is required at the specified test pressure through the test period. Prior to commencing test using air, ensure air will be at ambient temperature and specified test pressure.

.6 Do not exceed 5% of the specified test pressure as the allowable leakage are over the test period for other systems tested with air. Provide feed air pressure regulator with gauge and pressure safety valve with ring pressure set at not more than 20 kPag above the test pressure and adequately sized for both the compressor capacity and any condition that could result in pressure increases.

.7 Wet all joints using a mixture of soap and water in systems tested with air. Remake all joints which display leakage and retest. For stainless steel piping, repeat cleaning and passivation procedure indicated above for the entire piping section, then test for adequate passivation in the re-worked area.

END OF SECTION

DETAILED PIPING SPECIFICATION

1. GENERAL

1.1 Work Included

.1 The piping specification sheets on the following pages detail the requirements for each type of process pipe included in the Work.

.2 The piping materials are listed on the specification sheets.

1.2 Definition

.1 Abbreviations used in the Detailed Piping Specification Sheets.

Abbreviation	Commodity	Pipe Material
FSW (W3)	Flushing Water	New Dewatering Building: PVC Schedule 80 (connections to SS) - Interior Stainless Steel in the Control Chamber Building- Interior HDPE DR 17- exterior
DRA	Drain	PVC Schedule 80 - interior
VNT	Vent	PVC Schedule 80 - interior
SCP	Scum	Stainless Steel - interior HDPE DR17 - exterior
FLT	Filtrate	Stainless Steel - Interior
PD	Process Drain	Stainless Steel -Interior HDPE DR17 exterior
LCP	Liquid Polymer	PE tubing - interior
MP	Mixed Polymer	PVC Schedule 80 - interior
FOA	Foul Air	FRP - interior FRP - exterior, heat traced

2. PRODUCTS

2.1 Schedule

.1 Detailed Pipe Specification Sheets follow.

.2 Connections to all major equipment and valves shall be flanged. Grooved, butt welded or solvent welded connections are not permitted without prior approval from the Contract Administrator.

.3 Transitions between pipe materials are not shown on Contract Drawings and are incidental to Contract Work.

DETAILED PIPING SPECIFICATION

Chemical Feeds, Drains, Vent to Outside, Flushing Water in New Building

GENERAL

PROCESS FLUID	SYMBOL	MAXIMUM CONDITIONS		TEST CONDITIONS	
		PRESSURE (kPa)	TEMP. (°C)	PRESSURE (kPa)	DURATION (Min.)
Flushing Water, Drain, Vent, Mixed Polymer,	FSW (W3), DRA, VNT, FLT, MP,	750	0-30	1125	120

PIPE

LOCATION	SIZE (mm)	MATERIAL	RATING	SPECIFICATIONS	REMARKS
All	10 – 300	PVC	Schedule 80	ASTM D1785, CSA 137.3	

JOINTS

LOCATION	SIZE (mm)	TYPE	MAXIMUM SPACING	SPECIFICATIONS	REMARKS
All	10 – 65	Grooved or Butt	N/A	ASTM D2467, D2564	
	10 – 65	Welded	12 m	ASTM D2467	Note 1
	≥75	Unions	N/A	ASTM D2467, D2564	
	≥75	Grooved, Butt Welded or Flanges	12m	ASTM D2467	Note 1

FITTINGS AND APPURTENANCES

ITEM	SIZE (mm)	MATERIAL	RATING	SPECIFICATIONS	REMARKS
Flanges	10 – 300	PVC	Schedule 80		
ELL - Short Radius ELL - Long Radius, Couplings, Tees, Reducers, Reducing Outlets and Laterals	10 – 300	PVC	Schedule 80	ASTM D2467, Grooved or flanged	
ITEM	**SIZE (mm)**	**MATERIAL**	**RATING**	**SPECIFICATIONS**	**REMARKS**
Plug	10 – 300	PVC	Schedule 80	ASTM D2467, Flanged	
Cap	≥75	PVC	Blind Flange Schedule 80		
Flange Hardware		316SS			
Flange Gaskets		Neoprene, Viton		ASTM F477	Note 3
PVC Solvent				ASTM D2564	Note 3

NOTES

1. Provide, as a minimum, unions, flanges, and flange adapters to allow for pipe and equipment disassembly and reassembly.
2. Gaskets material to be compatible with designated chemical solution.
3. Provide pipe support. Piping supports are generally not shown on the Drawings, see Section 40 05 80 Process Pipe Hangers and Supports.
4. Male Adapters not to be used with PVC piping.

DETAILED PIPING SPECIFICATION

Process Piping (Inside Buildings)

GENERAL

PROCESS FLUID	SYMBOL	MAXIMUM CONDITIONS		TEST CONDITIONS	
		PRESSURE (kPa)	TEMP. (°C)	PRESSURE (kPa)	DURATION (Min.)
Flushing Water, Scum, Filtrate, Process Drain	FSW (W3), SCP, FLT, PD	750	0-30	1125	120

PIPE

LOCATION	SIZE (mm)	MATERIAL	RATING	SPECIFICATIONS	REMARKS
Inside Buildings	10 – 300	Stainless Steel 316	Schedule 40S	ASTM A312	

JOINTS

LOCATION	SIZE (mm)	TYPE	MAXIMUM SPACING	SPECIFICATIONS	REMARKS
All	≥38	Butt Weld	N/A		

FITTINGS AND APPURTENANCES

ITEM	SIZE (mm)	MATERIAL	RATING	SPECIFICATIONS	REMARKS
Flanges, FF or RF	≥38	Stainless Steel 316	Class 150	Material: Same as Pipe Dimensions: ANSI B16.5 ANSI B16.9	
ELL – Short Radius ELL – Long Radius, Tees, Reducers, Reducing Outlets, Laterals and Caps	≥38	Stainless Steel 316	Same as Pipe	Material: Same as Pipe Dimensions: ANSI B16.9	
Plug	≥38	Stainless Steel 316	Class 150 Blind Flange	Material: Same as Pipe Dimensions: ANSI B16.5	
ITEM	**SIZE (mm)**	**MATERIAL**	**RATING**	**SPECIFICATIONS**	**REMARKS**
Flanged Adaptors	≥38	Same as Pipe	Same as Pipe	Flange: ANSI B16.5	
Flanged Gaskets		Neoprene		ASTM F477	
Grooved Joint Gaskets	≥38	Neoprene		AWWA C606	
Grooved Joint and Fittings	>38	Stainless Steel 316			

NOTES

DETAILED PIPING SPECIFICATION

Outdoor Piping

GENERAL

PROCESS FLUID	SYMBOL	MAXIMUM CONDITIONS		TEST CONDITIONS	
		PRESSURE (kPa)	TEMP. (°C)	PRESSURE (kPa)	DURATION (Min.)
Flushing Water, Scum, Filtrate, Process Drain	FSW (W3), SCP, FLT, PD	750	0-30	0-1125	120

PIPE

LOCATION	SIZE (mm)	MATERIAL	RATING	SPECIFICATIONS	REMARKS
All	10-900	HDPE	DR17	ASTM D3350	

JOINTS

LOCATION	SIZE (mm)	TYPE	MAXIMUM SPACING	SPECIFICATIONS	REMARKS
All	10-900	Thermal butt fusion	N/A	ANSI/AWWA C207	

FITTINGS AND APPURTENANCES

ITEM	SIZE (mm)	MATERIAL	RATING	SPECIFICATIONS	REMARKS
PP Compression Fittings	10-32	PP		Design Standard Cepex Performance Series	
ELL - Short Radius ELL - Long Radius, Couplings, Tees, Reducers, Reducing Outlets and Laterals	40-900	HDPE	1100 kPa	ASTM A105	

NOTES

DETAILED PIPING SPECIFICATION

All Inside Pipes Passing through Concrete Slabs, Floor, Wall and Submerged Pipes

GENERAL					
PROCESS FLUID	**SYMBOL**	**OPERATING LIMITS**		**TEST CONDITIONS**	
		PRESSURE (kPa)	**TEMP. (°C)**	**PRESSURE (kPa)**	**DURATION (Min.)**
Flushing Water, Vent, Scum, Filtrate, Mixed Polymer, Process Drain	FSW (W3), VNT, SCP, FLT, MP, PD	0-750	0-50	1200	120

PIPE					
LOCATION	**SIZE (mm)**	**MATERIAL**	**RATING**	**SPECIFICATIONS**	**REMARKS**
Below Structures	≥38	Stainless Steel 316	Schedule 40S	ASTM A312	
Submerged	≥38	Stainless Steel 316	Schedule 40S	ASTM A312	Note 1

JOINTS					
LOCATION	**SIZE (mm)**	**TYPE**	**MAXIMUM SPACING**	**SPECIFICATIONS**	**REMARKS**
Below Structures	≥38	Butt Weld	N/A		
Submerged	≥38	Butt Weld Grooved Joint	N/A 20 m	AWWA C606	

FITTINGS AND APPURTENANCES					
ITEM	**SIZE (mm)**	**MATERIAL**	**RATING**	**SPECIFICATIONS**	**REMARKS**
Flanges, FF or RF	≥38	Stainless Steel 316	Class 150	Material: Same as Pipe Dimensions: ANSI B16.5 ANSI B16.9	
ELL – Short Radius ELL – Long Radius, Tees, Reducers, Reducing Outlets, Laterals and Caps	≥38	Stainless Steel 316	Same as Pipe	Material: Same as Pipe Dimensions: ANSI B16.9	
Plug	≥38	Stainless Steel 316	Class 150 Blind Flange	Material: Same as Pipe Dimensions: ANSI B16.5	
ITEM	**SIZE (mm)**	**MATERIAL**	**RATING**	**SPECIFICATIONS**	**REMARKS**
Flanged Adaptors	≥38	Same as Pipe	Same as Pipe	Flange: ANSI B16.5	
Flanged Gaskets		Neoprene		ASTM F477	
Grooved Joint Gaskets	≥38	Neoprene		AWWA C606	
Grooved Joint and Fittings	>38	Stainless Steel 316			

NOTES

1. Piping located in the headspace of tanks is considered "submerged".

END OF SECTION

PROCESS PIPE JOINTS AND EQUIPMENT CONNECTIONS

1. GENERAL

1.1 Description

.1 This Section describes acceptable methods for jointing and connecting piping to equipment and appurtenances.

.2 Refer to the general piping requirements of Section 40 05 13. Use the general requirements specified in this Section and Section 40 05 13.

1.2 Submittals

.1 With the submittals required in Section 01 33 00, provide a listing of joining and connecting techniques used in the performance of the Work.

.2 Grooved joint products shall be shown on Drawings and product submittals.

1.3 Coordination

.1 Coordinate the jointing techniques with the piping requirements and ensure that the connection techniques match the requirements of the equipment and ancillary devices to which piping must attach.

1.4 Quality Assurance

.1 Refer to Section 40 05 13 for welding quality assurance requirements.

.2 All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

.3 All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

1.5 Shipment, Protection and Storage

.1 Refer to Division 1 and Section 40 05 13.

2. PRODUCTS

2.1 Function

.1 Provide for the joining of the pipe materials, fittings, and appurtenances as described below, for the piping systems shown.

2.2 General

.1 Connect piping using joints not readily disassembled only where shown and where not otherwise specified. Provide joints which may be disassembled as indicated on the Drawings, and at the minimum, within 1000 mm of any connection to equipment, on both

sides of structural penetrations, within 600 mm of all threaded end valves, and at the spacing specified in the detailed piping specification sheets.

.2 Where new pipe crosses a new or existing structural expansion joint and the pipe is supported from each side of the structure, provide a flexible coupling in pipe to allow for differential settlement. Select flexible connection suitable for pipe material.

.3 Unions and flanges for servicing and disconnect are not required in installations using grooved mechanical joint couplings. (The couplings shall serve as disconnect points if required.)

.4 Connection hardware and bolts shall be 316 stainless steel.

2.3 Welding Materials

.1 Use welding materials conforming to CSA W48.1.

.2 Provide electrodes compatible with the material welded and which deposit metal with strength and corrosion resistance properties at least equivalent to the base metal.

.3 Provide proper storage for welding rod. Provide rod ovens in cold or inclement weather.

.4 Keep stainless steel rods in marked containers, separate from other materials.

2.4 Dissimilar Metal Connections

.1 Where dissimilar metals are to be connected, furnish dielectric fittings or isolating flanges.

2.5 Stainless Steel Pipe

.1 Less than 75 mm in diameter: socket-weld pipe. Where disassembly is required, use threaded unions.

.2 Equal to or greater than 75 mm in diameter: butt-weld pipe; where disassembly is required, use flanges or grooved fittings.

.3 Flanged Connections:

.1 Make flanges on stainless steel piping stainless steel to be weld neck flanges.

.4 Conform to ASTM A182 or ASTM A276, Class 150, for threaded connections to stainless steel pipe, threadolets to be shop welded to the pipe at the locations specified.

.5 Where grooved joint fittings are shown for use in stainless steel piping systems, meet the following requirements:

.1 Schedule 10 or 80 stainless steel shall be grooved using a grooving tool equipped with roll sets, specifically designed for stainless steel pipe.

.2 Fittings manufactured from stainless steel conforming to ASTM A403 or factory-fabricated from ASTM A312 stainless steel pipe.

.3 Grooved joint couplings shall consist of two stainless steel housing segments, pressure responsive elastomer gasket, and ASTM A449 zinc-electroplated steel or ASTM F593 / F594 stainless steel bolts and nuts.

.1 AGS series two-segment couplings for pipe sizes 350 mm and larger with lead-in chamfer on housing key and wide-width FlushSeal gasket. Acceptable products are Victaulic Style W89 (rigid) or approved equals. Use only in non-submerged conditions.

.2 Use flexible style couplings for all buried service pipe, all pipe greater than 300 mm in diameter, for pipe less than 300 mm in diameter in rack mounted piping assemblies, and for grooved joints adjacent to pump or blower suction and discharge where grooved joints are used for noise and vibration control. Acceptable products are Gustin-Bacon 100 and Victaulic Style 77S and AGS W77 or approved equals.

.3 Use rigid style couplings in all other applications. In sizes through 300 mm, housing key shall engage the bottom of the groove. Acceptable products are Victaulic Style 89 and W89 (DI) or 489 (SS) or approved equals.

.4 Verify coupling approved operating pressure specific to schedule and size of pipe.

.6 With the Contract Administrator's prior acceptance, flange assemblies may be substituted for above ground stainless steel piping which is not lined where rigid style couplings are shown or specified. Note any such substitutions in the submittals prior to fabrication.

2.6 High-Density Polyethylene

.1 Where not shown or otherwise specified, use flanged connections to AWWA-C110 with Class 150 cast iron backing flanges and rubber gasket cut to fit the joint.

.1 For approved piping systems, Victaulic couplings for HDPE pipe may be used in lieu of flanged or fusion welded joints.

.1 Style 905 Installation-Ready coupling or approved equals for plain end HDPE pipe, sizes 50 mm through 350 mm (2"-14").

.2 Style 907 Installation-Ready transition couplings or approved equals for Plain end HDPE to grooved end IPS steel pipe in sizes 50 mm through 350 mm (2"-14").

.3 Style 995N coupling for plain end HDPE pipe or approved equals in sizes 250 mm through 500 mm. (10"-20").

.4 Style 908 Double Grooved Coupling for double grooved end HDPE pipe to HDPE pipe connection, Sizes 400 mm – 915 mm (16"-36"). Grooved HDPE must be completed by Victaulic Groover and conform to AGS style wedge shaped grooves.

.5 Style 908 Double Grooved Coupling for Double Grooved end HDPE pipe to IPS steel pipe in sizes 400 mm – 915 mm (16"-36"). The usage of a "908 Vic Ring" on IPS steel needed for connection.

.2 For approved piping systems, UNI-Coupling couplings for HDPE piping may be used in lieu of flanged or fusion welded joints for couplings. Pipe stiffeners shall be used for all HDPE pipe ends.

.1 UNI-Plastgrip coupling or approved equals for plain end HDPE pipe, sizes 50 mm through 600 mm.

2.7 PVC Piping

.1 Where not shown or otherwise specified, use Schedule 80 flanged PVC and FRP piping. Provide flanges or unions where disassembly is required.

2.8 Flanges

.1 General requirements for flanges are as follows:

.1 Provide compatible flanges for mating to equipment or valves.

.2 Provide flat-faced flanges on each side of butterfly valves.

.3 For stainless steel piping, provide weld neck flanges on both sides of wafer or lug body valves.

.4 Use of weld neck flange on schedule 10 and 80 stainless steel piping systems is acceptable.

.2 Do not use slip-on flanges that are attached to a pipe by means of set screws and gaskets (uni-flange, etc.)

2.9 Threaded Couplings

.1 Make screwed joints using American Standard threads to ANSI B1.20.1.

.2 Use Teflon tape as thread lubricant for threaded joints.

.3 Provide threaded-end to flanged-end adapters where required to connect to flanges.

2.10 Grooved Joint Couplings

.1 For stainless steel pipe, provide cut grooves in pipe and fittings in accordance with AWWA C606. Alternatively, rolled grooves and roll-groove type joints may be used on bare stainless steel pipe.

.2 For all grooved joints, grind or buff edges to a minimum radius of 6 mm. Coordinate with coupling manufacturer to ensure proper fit.

.3 In grooved joint piping systems requiring end-seal type gaskets, provide grooved joint couplings and grooved pipe in accordance with gasket manufacturers recommendations.

.4 Where grooved joint piping systems connect to equipment or to flanged valves, meters, or other sensing devices, use grooved joint flanges or flange adapters. Acceptable products: Victaulic flanges and flange adapters.

.5 Install in accordance with the manufacturer's latest published installation instructions.

2.11 Flexible Couplings

.1 Flexible couplings which are designated to be unrestrained at either end shall consist of a cylindrical centre ring, two follower rings, two resilient gaskets, and connecting bolts.

.2 Flexible couplings which are designated to be restrained at one end shall consist of a cylindrical centre ring, a companion flange, one follower ring, two resilient gaskets, and connecting bolts.

.3 The centre ring shall be steel, shop coated for corrosion protection.

.4 The gaskets shall be constructed of material suitable to the service conditions.

.5 Flexible flange adapters shall be installed at all equipment and valves to facilitate easy removal/re-installation.

.6 Couplings to be designed to withstand 100 psi in pipe.

.7 Acceptable Manufacturer:

.1 Victaulic, style 77DX duplex stainless steel flexible coupling.

.2 Approved equals.

2.12 Yard Piping Connections

.1 For stainless steel building pipe penetrations connected to HDPE and for connections of HDPE to HDPE, sleeve type couplings shall be used.

.2 Yard piping connections shall provide restraint against pull out.

.3 Couplings shall offer ability for deflection of piping connections.

.4 Pipe stiffeners shall be used on all HDPE pipe ends.

.5 Connections shall be designed to withstand 100 psi in pipe.

.6 Acceptable Manufacturer:

.1 Victaulic.

.2 UNI-Coupling.

.3 Robar.

2.13 Equipment Connections

.1 Unless specified otherwise, comply with the Table at the end of this Section for the pipe connection requirements for various types of equipment ends.

3. EXECUTION

3.1 Stainless Steel Welding

.1 Refer to Section 40 23 19 - Stainless Steel Pipe and Fitting.

3.2 High-Density Polyethylene Installation

.1 Pipe ends shall be clean and free from indentations, projections and roll marks for proper gasket sealing.

.2 The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified.

.3 Follow the latest copy of the Manufacturer’s field assembly and Installation.

.4 Instruction manuals and handbooks specific to the product being installed.

3.3 Flanged Joints

.1 Clean flanges and gaskets prior to connection.

.2 Lubricate gaskets with soapy water and apply anti-seize compound to the bolts.

.3 Bring flanges into close parallel and lateral alignment.

.4 Tighten bolts progressively. Proceed from side to side of the flange.

.5 Washers may not be used to take up excess bolt length.

.6 Provide approximately two full threads bolt projection beyond nuts.

.7 When joining steel to cast iron flanges, take care to avoid damage to the cast iron flange. Ensure both flanges are flat-faced and use full face gaskets.

.8 Align flanges which connect piping to mechanical equipment to close parallel and lateral alignment prior to tightening bolts. Do not place undue strain on the equipment.

.9 Provide flanges at spacings noted in the Drawings and in Section 40 05 13 to allow for pipe disassembly.

.10 Allow a minimum of 150 mm to face or 200 mm to edge of flange from wall, floor or ceiling unless otherwise shown on the Drawings.

.11 On gauge stainless steel piping, consider the flange assembly weight in the design of the piping supports.

3.4 Grooved Pipe Joints

.1 Groove all pipes to be joined by this method in accordance with the Manufacturer's recommendations.

.2 Where connecting grooved joint pipe to flanged equipment or valves, use a transition coupling a minimum of 150 mm in length with a Class 125 FF flange at one end and a grooved joint at the other, unless otherwise specified or shown.

.3 Alternately, use split flanges fabricated specifically for grooved joint pipe to connect to flanged equipment, valves, meters, or sensing devices. Provide restraint on joints to prevent valve body rotation when the operator is torqued.

.4 Provide joints at spacing noted in Section 40 05 13 to allow for pipe disassembly.

.5 Allow a minimum of 150 mm to face or edge of grooved joint coupling from wall, floor or ceiling unless otherwise shown.

.6 Pipe ends shall be clean and free from indentations, projections and roll marks in the area from pipe end to (and including) groove.

.7 Gasket shall be manufactured by the coupling manufacturer and verified as suitable for the intended service.

.8 A factory trained representative (direct employee) of the coupling manufacturer shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and product installation. The representative shall periodically visit the job site and review installation to ensure best practices in grooved joint installation are being followed. Contractor shall remove and replace any improperly installed products.

PROCESS PIPE JOINTS AND EQUIPMENT CONNECTIONS

Piping Materials	Pipe Types	Diameter Range	Equipment								
			Tubing/Various	**Brass or Bronze Female Thread**	**Cast Iron or Steel Female Thread**	**Cast Iron Flanged**	**Steel/Stainless Flanged**	**Steel/Stainless Plain End**	**Steel or Stainless Welding End**	**Fibreglass Flanged**	**PVC Female Thread**
Stainless Steel	Gauge & Schedule 10S	10 to 65		150 mm SS Threaded Nipple and Union Rating: Class 250	150 mm SS Threaded Nipple and Union Rating: Class 250			Flexible Joint Flanged One End Rating: Class 150 RF or Flange Adaptor and Van Stone Flange Rating: Class 150 RF			150 mm SS Threaded Nipple and Union Rating: Class 250
		Greater than 65				Rolled Angle Van Stone Flange Rating: Class 125 FF	Rolled Angle Van Stone Flange Rating: Class 150 RF	Flexible Joint Flanged One End Rating: Class 150 RF or Flange Adaptor and Van Stone Flange Rating: Class 150 RF	Butt Welded (SS Equip. End)	Rolled Angle Van Stone Flange Rating: Class 150 RF	
	Schedule 10/80	10 to 65		Socket Weld Nipple and Union Rating: Class 250	Socket Weld Nipple and Union Rating: Class 250			Flexible Joint Flanged One End Rating: Class 150 RF or Flange Adaptor and Van Stone Flange Rating: Class 150 RF			Socket Weld Nipple and Union Rating: Class 250
		Greater than 65				Rolled Angle Van Stone Flange Rating: Class 125 FF	Rolled Angle Van Stone Flange Rating: Class 150 RF	Flexible Joint Flanged One End Rating: Class 150 RF or Flange Adaptor and Van Stone Flange Rating: Class 150 RF	Butt Welded (SS Equip. End)		
PVC	Schedule 40	10 to 65									150 mm PVC Nipple and Union Rating: Schedule 80
		Greater than 65				PVC Van Stone Flange Rating: Class 125 FF	PVC Van Stone Flange Rating: Class 150 RF				
	Schedule 80	10 to 65		150 mm PVC Nipple and Union Rating: Schedule 80	150 mm PVC Nipple and Union Rating: Schedule 80						150 mm PVC Nipple and Union Rating: Schedule 80
		Greater than 65				PVC Flange (Sch.80) Rating: Class 125 FF	PVC Flange (Sch.80) Rating: Class 150 RF				

END OF SECTION

PROCESS PIPE GUIDES AND ANCHORS

1. GENERAL

1.1 Description

.1 This Section describes process pipeline guides and anchors to be installed integrally with the piping. These items are an integral component of the piping support system for which other requirements are described in Section 40 05 13.

.2 Refer to the general piping requirements of Section 40 05 13 Use the general requirements specified in this Section and Section 40 05 13.

1.2 Submittals

.1 Provide Shop Drawings, signed and sealed by a Professional Engineer registered in the Province of Manitoba, for each type of pipeline support and anchor in accordance with the requirements of Sections 01 33 00 and Section 40 05 13. Refer to Drawings for details of pipe supports.

.2 Show the materials of construction and illustrations of the method of installation.

.3 Provide evidence that the Manufacturer has at least five (5) installations of similar size and type in satisfactory service for a period of not less than five (5) years.

1.3 Coordination

.1 Coordinate the guides and supports with the pipe support system. Ensure that the guides and supports are mounted in locations suitable for their intended function.

1.4 Quality Assurance

.1 Welding Requirements: refer to Section 40 05 13 for welding quality assurance requirements.

.2 Alignment: for large diameter (500 mm and larger), thin walled (6.4 mm and less) stainless steel piping supports laser align such that lateral and vertical misalignments between three consecutive supports do not exceed the wall thickness.

1.5 Process Air Pipe Anchors and Guides

.1 The process air pipe anchor and guide manufacturer will be regularly engaged in the business of designing and fabricating pipe anchors and guides of the size and type specified and shown on the Drawings.

1.6 Shipment, Protection and Storage

.1 Refer to Sections 40 05 13 and Division 1.

2. PRODUCTS

2.1 Function

.1 Provide the pipe guides and anchors as described below, for the piping systems shown on drawings.

2.2 Pipe Guides and Anchors

.1 Pipe guides:

.1 Unless otherwise shown or specified, provide spider type.. Provide AISI type 316 stainless steel. Refer to the following pages and the Drawings for location.

.2 Anchors:

.1 Unless otherwise specified, provide AISI type 316 stainless steel, anchor bolts; concrete and reinforcement to Division 3.

.2 Provide AISI type 316 stainless steel materials.

.3 Provide AISI type 316 stainless steel nuts, bolts, and washers.

2.3 Process Air Pipe Guides and Anchors

.1 Provide PTFE lower bearing surfaces not less than 2.4 mm thick of 100% virgin material in accordance with ASTM D1457 and with a 25% content of glass fiber filling.

.2 Provide PTFE lower bearing surfaces mechanically secured and bonded to a substrate made of 10 gauge or 3.2 mm thick type 316 stainless steel with a 6.4 mm welding lip all around.

.3 Provide PTFE with minimum 20 MPa tensile strength, tested in accordance with ASTM D638; 200% elongation minimum, tested in accordance with ASTM D638; and 216 plus or minus 0.03 relative density, tested in accordance with ASTM D792.

.4 Provide stainless steel components to ASTM A167; type 316.

.5 Provide stainless steel upper bearing surfaces with an annealed mirror finish in accordance with ASTM A480 and having a maximum surface roughness of 0.15 microns.

.6 Provide these filled Teflon to stainless steel slide bearings and with the dimensions shown on the Drawings.

.7 Use welding procedures which minimize distortion of the pipe guides and anchors, and avoid damage to the finished work or bonded materials. Stitch weld thin stainless steel.

.8 Finish members true to line, free from twists, bends, open joints, sharp corners and sharp edges.

.9 Provide fabrication tolerances as follows:

.1 Overall dimensions to within 3 mm.

.2 Machined surfaces to within 0.4 mm.

.3 Backing plates for sliding surfaces to within 0.8 mm.

.4 Deviation from flatness of PTFE surfaces to 0.2 mm maximum.

.5 Deviation from flatness of stainless steel surfaces intended for contact with PTFE to 0.0003 LH maximum.

.6 PTFE thickness to plus or minus 10% of the specified thickness.

.7 Parallelism of one sliding surface with respect to the mating sliding surface, as datum, to 0.2% of the longer side, maximum.

.8 Matching holes for bolts to register so that a gauge 2 mm smaller in diameter than the holes will pass freely through the assembled members at right angles to such members.

.9 Finished bolt holes to not more than 2 mm in diameter larger than the bolt diameter.

.10 Center-to-center distances between bolt holes to within 1 mm of the dimensioned distance.

.10 Drill or ream bolt holes.

.11 Provide vibration resistant type fasteners.

.12 Provide stainless steel sliding surfaces intended for contact with PTFE of one piece continuously welded around the perimeter to the back plate to prevent ingress of moisture. Provide the weld clean, sound, smooth, uniform, without overlaps, properly fused, and located outside the area of contact with PTFE.

.13 Machine or fine grind metal-to-metal contact surfaces. Machine sliding metal contact surfaces in the principal direction of movement. Machine after welding whenever possible.

.14 Provide metal surfaces in contact with PTFE with no openings or discontinuities, and a maximum surface roughness of three (3) microns.

.15 Remove abrasive materials from finished surfaces and clean with a degreasing agent.

.16 Protect finished surfaces from contamination and mechanical damage.

3. EXECUTION

3.1 Process Air Pipe Guides and Anchors

.1 Unless written permission has been obtained from the Manufacturer and from the Contract Administrator, do not dismantle the pipe guides after they have left the Manufacturer's shop, in order to prevent contamination of the sliding surfaces.

.2 Use stainless steel shims to laser-align supports before installing the piping. Tighten J-bolts and grout using liquid, non-shrink, epoxy grout. Prevent ingress of grout into the annular space between the J-bolts and their pipe casing (the use of flexible sealant is allowed). Concrete base foundations for anchors and sliding supports shall be built with the top surface approximately 25 mm below aligned bottom of support plate. Allow for this much epoxy grout at each location. Preparation and grouting to be completed in accordance to Specifications in Division 3.

.3 Construct of fabricate as indicated in the Drawings or use approved commercial systems as indicated above.

END OF SECTION

PROCESS VALVES

1. GENERAL

1.1 Description

.1 This Section specifies the supply, installation and testing of process valves.

.2 This Section shall be read in conjunction with the provided process and instrumentation drawings and general arrangement drawings.

.3 The Project will comprise of a variety of process valve applications depending on the provided process vendor packages. It is the responsibility of the Construction Contractor to assess and evaluate information provided, including specifications, drawings, and process control description to appropriately select, supply, and install the process valves.

1.2 Definitions and Interpretations

.1 Valve Identification:

.1 Valves are identified in the Drawings by valve symbols.

.2 Actuators:

.1 Refer to Sections 43 21 00 and Division 26 for detailed specifications and Actuator types respectively.

.3 Valve supplier to provide a complete working package for the valve and the actuator, as specified.

1.3 Submittals

.1 Shop Drawings: Submit the following information in accordance with Section 01 33 00:

.1 Catalogue cuts and/or Shop Drawings for each type of valve indicating the valve number, materials of construction, dimensions, head loss characteristics through the valve, operating torque and valve end configuration.

.2 Operating and Maintenance data for incorporation in Operation and Maintenance Manual, as specified in Section 01 33 00. Include complete description of operation together with detailed Drawings, a complete list of replacement and repair parts, and parts Manufacturer's identifying numbers.

.3 Affidavits and registration numbers described below in Quality Assurance.

1.4 Quality Assurance

.1 For butterfly valves to be installed below ground, provide affidavits of compliance with AWWA C504.

.2 Valves are to be marked in accordance with MSS SP-25.

.3 Provide affidavits of compliance, as required by AWWA C500 for gate valves.

1.5 Shipment, Protection and Storage

.1 Deliver valves to site and using loading methods which do not damage casings or coatings.

.2 Clearly tag valves stating size, type, coatings and mating parts.

.3 Store on-site until ready for incorporation in the Works using methods recommended by the manufacturer to prevent damage, undue stresses, or weathering.

2. PRODUCTS

2.1 General

.1 Provide valves of the same type, size range and service from a single manufacturer.

.2 Provide new, unused valves for the Works.

.3 Valve materials to be free from defects or flaws, with true alignment and bores.

.4 Unless otherwise indicated on the Process and Instrumentation Drawings or specified in other Sections, valves shall be the same size as the pipe run in which they are to be installed.

.5 Clearly mark valve bodies in raised lettering to indicate the valve type, rating, and where applicable, the direction of flow. Conform to MSS SP25.

.6 Provide padlockable lockout feature on all sizes of the following valve types.

.1 Automated Control Valves (electric); FCV. Refer to the Drawings for abbreviation definitions.

.2 Specialty Valves; FV and PRV only. Refer to the Drawings for abbreviation definitions.

.3 Manual and Electrical Isolation and Shut-off Valves; PV, BV, CV, SOL, and PRV only.

.7 Valves to open counter-clockwise.

2.2 Drawings

.1 The process drawings indicate major process valves required for the process to operate as intended.

.2 Provide drain, air vent, and flushing connections in accordance with this Division.

2.3 Valve Ends

.1 In pipe runs less than 75 mm diameter provide valves with female threaded ends, unless indicated otherwise. Threads to conform to ANSI B1.20.1.

.2 Valves in pipe runs equal to or greater than 75 mm diameter to be flanged unless indicated otherwise.

.3 For cast iron body valves, drill flanges to Class 125 pattern conforming to ANSI B16.1. For steel body valves, flanges to be Class 150 pattern or Class 300 pattern conforming to ANSI B16.5.

.4 Do not use grooved joint valve ends.

.5 Use flanged joints for buried and exterior valves. The flanges are to be compatible with the pipe and jointing technique used.

.6 Use flanged joints for buried butterfly valves.

.7 Lug style wafer body valves shall have tapped holes, suitable for the bolt spacing of the pipe flanges placed on either side.

.8 Wafer body valves shall have positioning holes, suitable for the bolt spacing of the pipe flanges placed on either side.

.9 Use wafer body butterfly valves only for control applications, and only if other valve(s) are provided for blocking and isolation. Use lug style or flanged wafer body butterfly valves if the function is blocking and isolation, including control valves where separate block and isolation valves are not provided.

.10 For gate valves, end flanges shall be integral with the gate valve body and be faced and drilled in accordance with ANSI B16.1, Class 125 flanges.

2.4 Manual Operators

.1 Provide valves with manual operators unless specifically indicated otherwise on the process schematic Drawings or mechanical Drawings or other Sections.

.2 For hand wheels, clearly show the direction of opening in raised lettering and symbols.

.3 Hand wheel diameter to conform to the following:

Nominal Valve Diameter (mm)	Minimum Hand Wheel Diameter (mm)
12	50
20	50
25	60
38	75
50	85
65	105
75	200
100	250
150	300
200	350
250	400
300	450
350	450
400	550
450	600
500	600

Nominal Valve Diameter (mm)	Minimum Hand Wheel Diameter (mm)
600	600

.4 The maximum rim pull on a hand wheel not to exceed 300 N when one side of the valve is at test pressure and the other side is at atmospheric pressure. Where a shaft mounted hand wheel would require greater than this force to operate, provide a gear operator. Unless different operators are scheduled or shown in the Drawings, conform to the following minimum requirements:

.1 Globe and Needle Valves: less than 200 mm, hand wheel; equal to or greater than 200 mm, gear operator.

.5 Supply stem extensions and valve boxes for buried valves and stem extensions for submerged valves as specified in the Drawings.

.6 Provide operating tees as required.

.7 Lever operators to conform to the following dimensions:

Nominal Valve Diameter (mm)	Minimum Length of Lever (mm)
6	80
12	80
20	100
38	150
50	150
65	150
75	175
100	225
150	250
200	300
250	450
300	450

.8 Quarter turn lever operators to be perpendicular to the pipe run when the valve is closed.

.9 Lever operators on ball valves to be two position. Provide butterfly valves with ten (10) position latching levers except where used to balance air flows. Where used to balance air flows provide infinite position, screw down levers.

.10 The maximum pull at the end of the lever arm not to exceed 300 N when one side of the valve is at test pressure and one side is at atmospheric pressure. Where greater than this force would be required to operate the valve with a lever, provide a gear operator. Unless different operators are scheduled or shown in the Drawings, conform to the following minimum requirements:

.1 Ball Valves: less than 150 mm, lever operator; greater than or equal to 150 mm, gear operator.

.2 Butterfly Valves: less than 250 mm, lever operator; greater than or equal to 250 mm, gear operator.

.11 Gear operator to be worm gear type, equipped with a hand wheel and a visual indicator of the valve position. Equipment operators with adjustable mechanical stop-limiting devices to prevent over-travel of the disc/ball in the open and closed positions and which are self-locking and designed to hold the valve in any intermediate position between full open and full closed. Gear operators shall be grease lubricated.

.12 Operators for exposed service shall be gasketed for weatherproof service. Place gear boxes above ground and liquid surfaces.

.13 For manual valves on lines 75 mm and greater, mounted over 2.0 m above the operating floor, provide chain wheel gear operators. Design the operator so that a force of 150N is sufficient to open the valve when one side of the valve is at test pressure and the other side is at atmospheric pressure. The chain pulley to mesh positively with the chain. Extend the chain from the valve operator to operating height 1.2 m above the floor or as directed by the Contract Administrator. The exact dimensions shall be field determined. Provide approved chain hooks where required to prevent chain from hanging within traffic paths.

2.5 Stem and Couplings

.1 Provide operating stems and couplings of 316 stainless steel.

.2 Provide the stem with a slenderness ratio (L/R) less than 200.

.3 Hollow stems are acceptable but they shall be provided with stem guides (mounting brackets) and thrust bearings designed to carry the weight of the stem extension, eliminate load on the stem, and prevent buckling.

.4 Machine cut the threaded portion of the stem.

.5 For stems in more than one piece and with a diameter of 44.5 mm and larger, join the different sections together by threaded and bolted connections.

.6 Groove and key the couplings. The couplings are to be of greater strength than the stem.

.7 Provide stem guides of stainless steel, type 316 and UHMWPE bushed.

2.6 Valve Stem Extensions

.1 Provide 316SS valve stem extensions where additional clearance is required for pipe insulation, for all submerged valves and other locations where valve operation without the extension is difficult.

.2 Where angle valve stem extensions are employed, they shall be angle geared. Universal joint types are not permitted.

.3 For all valves equal to or greater than 150 mm requiring stem extensions, provide pedestal mounted operators.

2.7 Pressure (Self) Regulating Valves

.1 Pressure (self) regulation (PRV) valves shall be supplied, installed and calibrated under this Division.

2.8 Surge Anticipating Valve

.1 Surge anticipating valves shall be supplied, installed and calibrated under this Division.

2.9 Air Relief or Vacuum Safety (ARV) Valves

.1 Air relief or vacuum safety (ARV) valves shall be supplied, installed and calibrated under this Division.

.2 Provide connection to the pipe.

.3 Valve discharge to be piped to within 50 mm of the floor.

2.10 Protective Coatings

.1 Cathodic Protection:

.1 Unless otherwise specified, provide valves coated in accordance with Division 9.

.2 Unless otherwise specified, provide cathodic protection to underground valves.

2.11 Spare Parts

.1 Provide one (1) spare valve including the appropriate operator for each valve type and size.

.2 Provide a list of all spare parts which would be expected to be required under normal conditions for a period of five (5) years. At the Contract Administrator's request, provide a price for these parts.

3. EXECUTION

3.1 Preparation

.1 The valve and piping arrangement indicated in the Drawings is based on typical dimensions for valves of the specified type. Make the necessary modifications in the piping to allow for discrepancies between the valve dimensions shown and those supplied for the Works.

.2 Prior to the installation of the valves, field measure and check all equipment locations, pipe alignments, and structural installation. Ensure that the valve location and orientation provides suitable access to manual operators and that sufficient space and accessibility is available for electric actuators.

.3 Where conflicts are identified, inform the Contract Administrator and initiate the necessary piping modifications at no cost to the City.

3.2 Valve Installation

.1 In horizontal pipe runs other than in locations where space does not permit, mount all valves except for butterfly valves and trunnion ball valves with a vertical operating shaft with the actuator at the top. Avoid installing a valve with the operator shaft pointing down.

.2 Mount butterfly valves and ball valves with the shaft in a horizontal orientation unless impractical.

.3 Mount valves in a position for easy access to the operators and maintenance personnel.

.4 When joining valves to pipe or fittings, do not overtorque bolts to correct for misalignment.

.5 Support valves in position using temporary supports until valves are fixed in place.

.6 Permanently support valves to prevent transmission of loads to adjacent pipework and/or equipment.

.7 Where valves are installed in PVC pipework larger than 100 mm diameter, support valves independently and brace against operating loads and torque to prevent transmission of stresses to the adjacent pipework.

.8 Generally pipe supports and hangers are not shown unless for indication purposes only.

.9 Install valves which are bubble-tight in one direction to seal in a direction opposite to normal flow unless otherwise noted or directed by the Contract Administrator.

.10 Unless otherwise specified, install single seated ball valves with the seat downstream. Install at tank connections with seat away from tank. Install on pump discharge and suction lines with seat adjacent to the pump.

.11 Install all valves in accordance with the Manufacturer's recommendations.

.12 Protect valves installed below grade with a shrink sleeve or polyethylene sheath attached to the pipe with tapewrap.

.13 Insert wafer and lug wafer butterfly valves between the flanges in the closed position, align and bolt finger-tight. Then open the valve fully before working the bolts. Test that the disk does not catch the edge of the flange on closing and opening.

3.3 Valve Testing

.1 Ensure that the position indicated by the lever or actuator matches the actual position of the valve.

.2 Operate valves under simulated and/or actual process conditions to ensure they operate as intended.

.3 Pressure test the valves in conjunction with the pipes in which the valves are installed as specified.

END OF SECTION

DETAILED PROCESS VALVE SPECIFICATION SHEETS

1. GENERAL

1.1 Description

.1 Provide the valve type as indicated in the Drawings by the valve symbol shown. See the valve tables attached to this Section for guidance to specific valve types suitable for a given commodity and line size.

1.2 Measurement and Payment

.1 Requirements of this Section shall not be measured separately for payment and shall be carried in the Construction Contractor's Balance of Contract Cost item.

1.3 Definitions

.1 Abbreviations used:

.1 ARV - Air Relief or Vacuum Safety Valve.

.2 BFV - Butterfly Valve.

.3 BV - Ball Valve.

.4 CV - Check Valve.

.5 PRV - Surge Relief Valve.

.6 FCV - Flow Control Valve.

.7 PV - Plug Valve.

.8 KV - Knife Gate Valve.

.9 SOL - Solenoid Valve

2. PRODUCTS (NOT USED)

3. EXECUTION (NOT USED)

ARV

GENERAL:						
			OPERATING LIMITS		**DESIGN LIMITS**	
TYPE OF VALVE	**SYMBOL**	**TYPE OF COMMODITY**	**PRESSURE (kPag)**	**TEMP. (°C)**	**PRESSURE (kPag)**	**TEMP. (°C)**
Air and Vacuum Relief Valve	ARV	Liquid	500	0-40	1000	40

TYPICAL SERVICE:			
Direct acting air			
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	MATERIAL	Reference Document	
Body	Cast Iron ASTM A126, Gr.B	Size Range	<50 mm
Float	Stainless Steel	Rating	Class 125
Seats	Buna-N	Body/Valve Ends	Threaded
Stem	Stainless Steel	Type of Disc	
Internal Linkage	Stainless Steel	Operator	
		Actuator	
		Lining	
		Coating	

NOTES:

1. Air valves shall be designed for automatically exhausting air from a pipeline when it is being filled with water at a high rate. They should be designed to automatically ventilate a pipeline where it is being emptied of water. The air flow rate shall be sufficiently high to prevent the development of high vacuum pressure in the line.
2. The valves shall be suitable for wastewater application.
3. Complete with isolation ball valve as recommended by the manufacturer.
4. Complete with throttle device.

ACCEPTABLE PRODUCTS		
APCO	Valmatic	Cla-Val
Crispin	ARI	

FCV

GENERAL

TYPE OF VALVE	SYMBOL	TYPE OF COMMODITY	OPERATING LIMITS		DESIGN LIMITS	
			PRESSURE (kPag)	TEMP. (°C)	PRESSURE (kPag)	TEMP. (°C)
Flow Control Valve – Plug Valve	**FCV**	Liquid	0-750	5-30	1200	35

TYPICAL SERVICE

Automatically Modulating Flow Control Valve for Liquid Service.

VALVE MATERIALS		VALVE DESCRIPTION	
ITEM	MATERIAL	Reference Document	API 609
Body	Cast Iron A126 Class B (Ballcentric plug valve body)	Size Range	100 mm
Plug	Rubber Coated Ductile Iron ASTM A536	Rating	Class 125
Disc Trim	Not Mandatory	Body/Valve Ends	Lug Wafer (Note 1)
Seats	Buna-N or EPDM	Type of Disc	
		Operator	
		Actuator	Electrical
		Lining	
		Coating	

NOTES

1. Full lug, wafer style body for placement between two Class 125 flanges.
2. See Division 40.
3. Valve shall have full shut-off capability.

ACCEPTABLE PRODUCTS

Flomatic	Cla-Val	Watt	Singer
Mueller-Pratt	DeZurik		Keystone-Emerson

BV

GENERAL						
TYPE OF VALVE	**SYMBOL**	**TYPE OF COMMODITY**	**OPERATING LIMITS**		**DESIGN LIMITS**	
			PRESSURE (kPag)	**TEMP. (°C)**	**PRESSURE (kPag)**	**TEMP. (°C)**
Ball Valve	**BV**	Liquid	0 – 900	5 to 30	1400	35

TYPICAL SERVICE
On/Off Valve for Process Lines for wastewater and sludge.

VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	MATERIAL	Reference Document	MSS-SP72 (Note 2)
Body	Cast Steel or Cast Iron or Steel	Size Range	50 mm to 150 mm (Note 3)
Ball	Stainless Steel (304 or 316), Cast Iron/Teflon Fused	Rating	CWP 1400 kPag
Packing	Reinforced PTFE or AFE	Body/Valve Ends	Flanged
Seats	Reinforced PTFE	Pattern	Two-Piece, Full Port
Shaft	Stainless Steel (304 or 315) (Note 1)	Operator	Gear if ≥ 150 mm
		Actuator	
		Lining	
		Coating	

NOTES

1. Blowout proof stem.
2. Provide Class 125 to suit PVC piping.
3. Provide trunnion mounted ball on all valves 250 mm diameter and greater.

ACCEPTABLE PRODUCTS

Kitz 150 SCTBZM-N	Watts G4000 ≤150 mm / CF 1800 ≤ 250 mm	Velan F-10402-SSGI	American Valve 4000
Crane/Virgo S2-RFI-F-C6-F-L			

BV

GENERAL						
TYPE OF VALVE	**SYMBOL**	**TYPE OF COMMODITY**	**OPERATING LIMITS**		**DESIGN LIMITS**	
			PRESSURE (kPag)	**TEMP. (°C)**	**PRESSURE (kPag)**	**TEMP. (°C)**
Ball Valve	**BV**	Liquid/Air	0-850	5-120	1275	140

TYPICAL SERVICE
General service valve for process air, process liquid and utility lines.

VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	MATERIAL	Reference Document	Body Material: ASTM A351 (Note 2)
Body	316SS CF8M body	Size Range	10 mm to 65 mm
Ball	Stainless Steel - floating	Rating	CWP 1000 kPag
Packing	Reinforced PTFE	Body/Valve Ends	Female Threaded or Flanged (Note 3)
Seats	Reinforced PTFE	Pattern	Two-Piece, Full Port
Shaft	Stainless Steel (Note 1)	Operator	Lockable Lever; Gear if ≥ 150 mm
Stem	Blow out proof	Actuator	Manual or Electrical
		Lining	
		Coating	

NOTES

1. Blowout-proof stem.
2. When this valve is installed into a gas service it must comply with the applicable Gas Safety Branch requirements: also refer to Division 40.
3. For SA service flanged connections only, threaded valves for this service is unacceptable.

ACCEPTABLE PRODUCTS			
M. A. Stewart Model G2			
Apollo 76F-100-A Series (full port) or approved equal			

BV

GENERAL						
TYPE OF VALVE	**SYMBOL**	**TYPE OF COMMODITY**	**OPERATING LIMITS**		**DESIGN LIMITS**	
			PRESSURE (kPag)	**TEMP. (°C)**	**PRESSURE (kPag)**	**TEMP. (°C)**
Ball Valve	**BV**	Liquid	100-750	5 to 40	1000	60

TYPICAL SERVICE
Chemical Lines, Sample Lines, Utility Lines

VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	MATERIAL	Reference Document	Material: ASTM D1784 (Grade A)
Body	PVC	Size Range	10 mm to 65 mm
Ball	PVC – floating ball	Rating	CWP 1000 kPag
Packing	O-Ring, EPDM or Viton (Note 4)	Body/Valve Ends	Schedule 80, Female Threaded, True Union
Seats	PTFE	Pattern	Full Port
Shaft	PVC (Note 1)	Operator	Lockable Lever
Stem	Blow out proof	Actuator	
		Lining	
		Coating	

NOTES

1. Blowout-proof stem.
2. Bi-directional.
3. This valve is for use in PVC piping systems only.
4. Material to be compatible with commodity.
5. NSF certified.

ACCEPTABLE PRODUCTS

Chemline 21 Series	Hayward Safe-Block	Nibco Tru-Block PVC	Fabco Superbloc
IPEX VX-True Union			

CV

GENERAL						
TYPE OF VALVE	**SYMBOL**	**TYPE OF COMMODITY**	**OPERATING LIMITS**		**DESIGN LIMITS**	
			PRESSURE (kPag)	**TEMP. (°C)**	**PRESSURE (kPag)**	**TEMP. (°C)**
Check Valve	**CV**	Liquid	0-750	5-30	1200	35

TYPICAL SERVICE
Check valve for non-potable water and Flushing water (Note 1).

VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	MATERIAL	Reference Document	AWWA C508
Body	Cast Iron or Ductile Iron	Size Range	50 mm to 150 mm
Disc	Cast or Ductile Iron or Solid Bronze	Rating	Class 125
Seats	Bronze	Valve Ends	Flanged
Hinge pin, trim	Stainless Steel or Bronze	Type of Disc	Swing Check (Note 1)
		Operator	Note 1
		Actuator	
		Lining	
		Coating	Fusion bonded epoxy coating, interior and exterior

NOTES
1. For all check valves greater than 75 mm on pump discharges, provide weighted lever arm.

ACCEPTABLE PRODUCTS			
Crane 383 / 34612	DeZurik	Newman Hattersley T651	Milliken 801BBW
Jenkins 587J / 477LJ			

CV

GENERAL						
TYPE OF VALVE	**SYMBOL**	**TYPE OF COMMODITY**	**OPERATING LIMITS**		**DESIGN LIMITS**	
			PRESSURE (kPag)	**TEMP. (°C)**	**PRESSURE (kPag)**	**TEMP. (°)**
Check Valve	**CV**	Liquid	0-550	5-100	850	115

TYPICAL SERVICE
Chemical Lines, Sample Lines, Utility Lines

VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	MATERIAL	Reference Document	
Body	PVC	Size Range	25 mm to 50 mm
Disc	(Note 1)	Rating	Sch. 80
		Valve Ends	Flanged / Threaded / True Union
		Type of Disc	Ball Check (Note 1)
		Operator	
		Actuator	
		Lining	
		Coating	

NOTES
1. PVC ball. 2. Viton seat and seal.

ACCEPTABLE MANUFACTURERS			
Chemline	Fabco	Nibco	Hayward True Check

KV

GENERAL						
TYPE OF VALVE	**SYMBOL**	**TYPE OF COMMODITY**	**OPERATING LIMITS**		**DESIGN LIMITS**	
			PRESSURE (kPag)	**TEMP. (°C)**	**PRESSURE (kPag)**	**TEMP. (°C)**
Knife Gate Valve	**KV**	Liquid	0-100	5-30	1200	35

TYPICAL SERVICE
General Service and Isolation valve for wastewater service

VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	MATERIAL	Reference Document	
Body	316SS	Size Range	75 mm to 900 mm
Disc	316SS	Rating	Class 150
Seats	Buna N, NBR	Valve Ends	Lugged
Seals	Buna N, NBR	Type of Disc	
Shaft	Stainless Steel	Operator	RS, Handwheel, epoxy coated
Wiper Ring	Reinforced PTFE	Actuator	Note 1. Manual or Electrical
Pillars	Stainless Steel	Lining	
Stem	316SS	Coating	

NOTES
1. Bi-directional pressure rating 100 kPa, drip tight shut off with downstream flange removed. 2. Incompliance with MSS SP-81.

ACCEPTABLE PRODUCTS			
Trueline F8112	DeZurik KGC-BD	Pratt LVC77	MAS FCC84B
Fabro Valve C37C			

ARV

GENERAL						
TYPE OF VALVE	**SYMBOL**	**TYPE OF COMMODITY**	**OPERATING LIMITS**		**DESIGN LIMITS**	
			PRESSURE (kPag)	**TEMP. (°C)**	**PRESSURE (kPag)**	**TEMP. (°C)**
Air Relief Valve	ARV	Liquid	420	0-40	1000	40

TYPICAL SERVICE			
Non-Potable Water			
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIAL**		
Body, Cover	Ductile Iron ANSI B16.42	Size Range	38 mm
Cover	Ductile Iron	Rating	Class 150
Disc retainer and diaphragm washer	Cast Steel	Valve Ends	Flanged
Trim	Stainless Steel	Type of Disc	
Disc	Buna-N	Operator	
Diaphragm	Nylon Reinforced Buna-N	Actuator	
Stem	Stainless Steel	Lining	
Pilot Control	Bronze or Steel	Coating	

ACCEPTABLE PRODUCTS		
Singer	Flomatic	Cla-Val
Wilkins		

PV

GENERAL						
TYPE OF VALVE	**SYMBOL**	**TYPE OF COMMODITY**	**OPERATING LIMITS**		**DESIGN LIMITS**	
			PRESSURE (kPag)	**TEMP. (°C)**	**PRESSURE (kPag)**	**TEMP. (°C)**
Plug Valve	**PV**	Liquid	750	5-30	1200	35

TYPICAL SERVICE
Raw Wastewater Isolation, On/Off valve for wastewater and sludge.

VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	MATERIAL	Reference Document	API 593, MSS SP-078
Body	Cast Iron	Size Range	50 mm to 150 mm
Plug	Cast Iron (see plug coating)	Rating	Class 150
Seats	Nickel	Valve Ends	FF Flanges
Seals	O-Rings, Buna-N, Acyionitrile-butadene	Type of Plug	Eccentric (Ballcentric), port area not less than 100% of pipe area
Shaft	Steel	Operator	Square nut / gear operator
Bearings	Stainless Steel	Actuator	Manual or Electrical
		Lining	Abrasion Resistant
		Plug Coating	Buna-N, Al-Clad, or Hycar, or chloro-sulfonyl polyetheylene
		Coating	

NOTES
1. Gear operator for 150 mm and over. 2. Square nut and lever under 150 mm.

ACCEPTABLE PRODUCTS			
DeZurik Series PEC Eccentric	Val-Matic Series 5800R Cam-Centric	Pratt Ballcentric Plug	Victaulic Plug

SOL

GENERAL						
TYPE OF VALVE	**SYMBOL**	**TYPE OF COMMODITY**	**OPERATING LIMITS**		**DESIGN LIMITS**	
			PRESSURE (kPag)	**TEMP. (°C)**	**PRESSURE (kPag)**	**TEMP. (°C)**
Solenoid Valve	**SOL**	Liquid	0-600	0-30	1400	50

TYPICAL SERVICE
Non-Potable Water flushing water

VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	MATERIAL	Reference Document	
Body	Stainless Steel	Size Range	10 mm to 50 mm
Plug	Stainless Steel (304)	Rating	CWP 1400 kPag
Seats	Buna-N or FKM	Body/Valve Ends	Female Threaded
Shaft	Stainless Steel (304 or 315)	Pattern	
		Operator	
Power	Coordinate with the vendor	Actuator	Solenoid

ACCEPTABLE PRODUCTS		
ITT General Control sS21	ASCO Model Redhat	Or approved equal

END OF SECTION

VALVE SCHEDULE

AECOM

LIST of VALVES

Valve Tags to be completed by the Construction Contractor

Client:	City of Winnipeg
Project Name:	NEWPCC Primary Clarification Upgrade
Project No.:	60661262
Location:	Winnipeg MB

TYPE	CONNECTION
BALL	SCREWED
BUTTERFLY	FLANGED
DIAPHRAGM	SOCKET WELD
CHECK	BUTT WELD
PLUG	MECH. JOINT
NEEDLE	SOLDER
GATE	INTER. FLANGED
GLOBE	OTHER
OTHER	

Area:		
Rev	Date	By
0		

Valve Designation			Characteristics				Installed on	Actuator	Supplied by:	Installed by:
Vendor Drawing	AECOM Drawing	Tag No.	Size (mm ND)	Commodity	Process Type	Connect.	Line or Equipment			
Control Chamber Building										
	P3-X601	XV P31112	50	FSW	Ball Valve		Flushing Water (W3)	Electrical	Contractor	Contractor
	P3-X601	XV P32122	50	FSW	Ball Valve		Flushing Water (W3)	Electrical	Contractor	Contractor
	P3-X601	XV P32112	50	FSW	Ball Valve		Flushing Water (W3)	Electrical	Contractor	Contractor
	P3-X601	HV-P3110-E	200	SCP	Plug Valve		Scum	Manual	Contractor	Contractor
	P3-X601	HV-P3111-A	350	SCP	Plug Valve		Scum	Manual	Contractor	Contractor
	P3-X601	HV-P3112-A	350	SCP	Plug Valve		Scum	Manual	Contractor	Contractor
	P3-X601	XV-P31123	200	SCP	Plug Valve		Scum	Electrical	Contractor	Contractor
	P3-X601	XV-P31113	200	SCP	Plug Valve		Scum	Electrical	Contractor	Contractor
	P3-X601	HV-P3211-A	200	SCP	Plug Valve		Scum	Manual	Contractor	Contractor
	P3-X601	CV-P3211-B	150	SCP	Check Valve		Scum	Manual	Contractor	Contractor
	P3-X601	HV-P3211-B	150	SCP	Plug Valve		Scum	Manual	Contractor	Contractor
	P3-X601	HV-P3111-B	150	SCP	Plug Valve		Scum	Manual	Contractor	Contractor
	P3-X601	HV-P3112-B	150	SCP	Plug Valve		Scum	Manual	Contractor	Contractor
	P3-X601	HV-P3211-C	50	FSW	Ball Valve		Flushing Water (W3)	Manual	Contractor	Contractor
	P3-X601	XV P31101	350	SCP	Plug Valve		Scum	Electrical	Contractor	Contractor
	P3-X601	HV-P3113-A	250	SCP	Gate Valve		Scum	Manual	Contractor	Contractor
	P3-X602	XV P31102	75	FSW	Plug Valve		Flushing Water (W3)	Electrical	Contractor	Contractor
	P3-X602	HV-P3212-A	150	SCP	Plug Valve		Scum	Manual	Contractor	Contractor
	P3-X602	CV-P3212-B	100	SCP	Check Valve		Scum	Manual	Contractor	Contractor
	P3-X602	HV-P3212-B	100	SCP	Plug Valve		Scum	Manual	Contractor	Contractor
	P3-X602	HV-P3213-A	150	SCP	Plug Valve		Scum	Manual	Contractor	Contractor
	P3-X602	CV-P3213-B	100	SCP	Check Valve		Scum	Manual	Contractor	Contractor
	P3-X602	HV-P3213-B	100	SCP	Plug Valve		Scum	Manual	Contractor	Contractor
	P3-X602	XV P33111	100	SCP	Plug Valve		Scum	Electrical	Contractor	Contractor
	P3-X602	XV P33121	100	SCP	Plug Valve		Scum	Electrical	Contractor	Contractor
	P3-X602	XV P33131	100	SCP	Plug Valve		Scum	Electrical	Contractor	Contractor
	P3-X602	FV P33112	100	SCP	Plug Valve		Scum	Electrical	Contractor	Contractor
	P3-X602	FV P33122	100	SCP	Plug Valve		Scum	Electrical	Contractor	Contractor
	P3-X602	FV P33121	100	SCP	Plug Valve		Scum	Electrical	Contractor	Contractor
	P3-X602	FV P33131	100	SCP	Plug Valve		Scum	Electrical	Contractor	Contractor
	P3-X602	HV-P3313-A	100	SCP	Plug Valve		Scum	Manual	Contractor	Contractor

VALVE SCHEDULE

Valve Designation			Characteristics				Installed on	Actuator	Supplied by:	Installed by:
Vendor Drawing	AECOM Drawing	Tag No.	Size (mm ND)	Commodity	Process Type	Connect.	Line or Equipment			
	P3-X602	HV-P3313-B	100	SCP	Plug Valve		Scum	Manual	Contractor	Contractor
	P3-X602	XV P32121	50	FSW	Ball Valve		Flushing Water (W3)	Electrical	Contractor	Contractor
	P3-X602	XV P32132	50	FSW	Ball Valve		Flushing Water (W3)	Electrical	Contractor	Contractor
	P3-X602	HV-P3212-C	50	FSW	Ball Valve		Flushing Water (W3)	Manual	Contractor	Contractor
	P3-X602	HV-P3213-C	50	FSW	Ball Valve		Flushing Water (W3)	Manual	Contractor	Contractor
	P3-X602	HV-P3311-A	50	FSW	Ball Valve		Flushing Water (W3)	Manual	Contractor	Contractor
	P3-X602	HV-P3312-A	50	FSW	Ball Valve		Flushing Water (W3)	Manual	Contractor	Contractor
	P3-X602	HV-P3312-C	50	FSW	Ball Valve		Flushing Water (W3)	Manual	Contractor	Contractor
	P3-X602	HV-P3214-A	75	DRA	Plug Valve		Drain	Manual	Contractor	Contractor
	P3-X602	HV-P3311-B	75	DRA	Plug Valve		Drain	Manual	Contractor	Contractor
	P3-X602	HV--P3312-B	75	DRA	Plug Valve		Drain	Manual	Contractor	Contractor
	P3-X602	HV-P3312-D	75	DRA	Plug Valve		Drain	Manual	Contractor	Contractor
	P3-X602		50	Air	ARV		Air Relief	Manual	Contractor	Contractor
	P3-X602		50	Air	ARV		Air Relief	Manual	Contractor	Contractor
	P3-X603	HV-P3221-A	150	SCP	Plug Valve		Scum	Manual	Contractor	Contractor
	P3-X603	CV-P3221-B	150	SCP	Check Valve		Scum	Manual	Contractor	Contractor
	P3-X603	HV-P3221-B	150	SCP	Plug Valve		Scum	Manual	Contractor	Contractor
	P3-X603	XV P32212	75	FSW	Ball Valve		Flushing Water (W3)	Electrical	Contractor	Contractor
	P3-X603	HV-P3221-C	75	FSW	Ball Valve		Flushing Water (W3)	Manual	Contractor	Contractor
	P3-X603	XV P32211	75	FSW	Ball Valve		Flushing Water (W3)	Electrical	Contractor	Contractor
	P3-X604	HV-P3222-A	150	SCP	Plug Valve		Scum	Manual	Contractor	Contractor
	P3-X604	CV-P3222-B	100	SCP	Check Valve		Scum	Manual	Contractor	Contractor
	P3-X604	HV-P3222-B	100	SCP	Plug Valve		Scum	Manual	Contractor	Contractor
	P3-X604	HV-P3223-A	150	SCP	Plug Valve		Scum	Manual	Contractor	Contractor
	P3-X604	CV-P3223-B	100	SCP	Check Valve		Scum	Manual	Contractor	Contractor
	P3-X604	HV-P3223-B	100	SCP	Plug Valve		Scum	Manual	Contractor	Contractor
	P3-X604	XV P32223	38	FSW	Ball Valve		Flushing Water (W3)	Electrical	Contractor	Contractor
	P3-X604	XV P32233	38	FSW	Ball Valve		Flushing Water (W3)	Electrical	Contractor	Contractor
	P3-X604	HV-P3222-C	38	FSW	Ball Valve		Flushing Water (W3)	Manual	Contractor	Contractor
	P3-X604	HV-P3223-C	38	FSW	Ball Valve		Flushing Water (W3)	Manual	Contractor	Contractor
	P3-X604	HV-P3224-B	38	FSW	Ball Valve		Flushing Water (W3)	Manual	Contractor	Contractor
	P3-X604	XV P32222	100	SCP	Plug Valve		Scum	Electrical	Contractor	Contractor
	P3-X604	XV P32232	100	SCP	Plug Valve		Scum	Electrical	Contractor	Contractor
	P3-X604	HV-P3224-A	75	DRA	Plug Valve		Drain	Manual	Contractor	Contractor

VALVE SCHEDULE

Valve Designation			Characteristics				Installed on	Actuator	Supplied by:	Installed by:
Vendor Drawing	AECOM Drawing	Tag No.	Size (mm ND)	Commodity	Process Type	Connect.	Line or Equipment			
Scum Dewatering Building										
	P3-X607	CV-P3501-A	75	PD	Check Valve		Process Drain Sump	Manual	Contractor	Contractor
	P3-X607	CV-P3502-A	75	PD	Check Valve		Process Drain Sump	Manual	Contractor	Contractor
	P3-X607	HV-P3501-A	75	PD	Plug Valve		Process Drain Sump	Manual	Contractor	Contractor
	P3-X607	HV-P3502-A	75	PD	Plug Valve		Process Drain Sump	Manual	Vendor	Contractor
	P3-X607	HV-P3501-C	75	PD	Plug Valve		Process Drain Sump	Manual	Vendor	Contractor
	P3-X607	HV-P3502-C	75	PD	Plug Valve		Process Drain Sump	Manual	Vendor	Contractor
	P3-X607	HV-P3501-D	75	PD	Plug Valve		Process Drain Sump	Manual	Vendor	Contractor
	P3-X607	HV-P3501-B	50	FSW	Ball Valve		Flushing Water (W3)	Manual	Contractor	Contractor
	P3-X607	HV-P3502-B	50	FSW	Ball Valve		Flushing Water (W3)	Manual	Contractor	Contractor
	P3-X607	XV P35011	75	PD	Plug Valve		Process Drain Sump	Electrical	Contractor	Contractor
	P3-X607	XV P35012	75	PD	Plug Valve		Process Drain Sump	Electrical	Contractor	Contractor
	P3-X607	XV P35021	75	PD	Plug Valve		Process Drain Sump	Electrical	Contractor	Contractor
	P3-X607	XV P35022	75	PD	Plug Valve		Process Drain Sump	Electrical	Vendor	Contractor
	P3-X605	P3311-A	38	FSW	Ball Valve		Flushing Water (W3)	Manual	Vendor	Contractor
	P3-X605	P3311-B	38	FSW	Ball Valve		Flushing Water (W3)	Manual	Vendor	Contractor
	P3-X605	P3311-C	38	FSW	Ball Valve		Flushing Water (W3)	Manual	Vendor	Contractor
	P3-X605	P3311-F	38	FSW	Ball Valve		Flushing Water (W3)	Manual	Vendor	Contractor
	P3-X605	P3311-G	38	SCP	Ball Valve		Scum	Manual	Vendor	Contractor
	P3-X605	XV P33121	25	FSW	Air Actuated Valve		Flushing Water (W3)	Air Actuated	Vendor	Contractor
	P3-X605	XV P33123	25	FSW	Air Actuated Valve		Flushing Water (W3)	Air Actuated	Vendor	Contractor
	P3-X605	XV P33125	25	FSW	Air Actuated Valve		Flushing Water (W3)	Air Actuated	Vendor	Contractor
	P3-X605	P3311-D	75	SCP	Ball Valve		Scum	Manual	Vendor	Contractor
	P3-X605	P3311-E	75	SCP	Ball Valve		Scum	Manual	Vendor	Contractor
	P3-X605	XV P33118	75	SCP	Air Actuated Valve		Scum	Air Actuated	Vendor	Contractor
	P3-X605	XV P33117	75	SCP	Air Actuated Valve		Scum	Air Actuated	Vendor	Contractor
	P3-X605	P3312-A	75	SCP	Ball Valve		Scum	Manual	Vendor	Contractor
	P3-X605	P3312-B	75	SCP	Ball Valve		Scum	Manual	Vendor	Contractor
	P3-X605	P3312-C	75	SCP	Ball Valve		Scum	Manual	Vendor	Contractor
	P3-X605	P3311-H	50	DRA	Ball Valve		Drain	Manual	Contractor	Contractor
	P3-X605	HV-P3413-A	20	FSW	Ball Valve		Flushing Water (W3)	Manual	Contractor	Contractor
	P3-X605	HV-P3413-B	20	FSW	Ball Valve		Flushing Water (W3)	Manual	Contractor	Contractor
	P3-X605	HV-P3413-C	20	FSW	Ball Valve		Flushing Water (W3)	Manual	Contractor	Contractor
	P3-X605	XV P33112	50	FSW	Ball Valve		Flushing Water (W3)	Electrical	Contractor	Contractor
	P3-X605	HV-P3413-D	50	FSW	Ball Valve		Flushing Water (W3)	Manual	Contractor	Contractor
	P3-X605	HV-P3413-E	50	FSW	Ball Valve		Flushing Water (W3)	Manual	Contractor	Contractor
	P3-X605	HV-P3413-F	50	FSW	Ball Valve		Flushing Water (W3)	Manual	Contractor	Contractor
	P3-X606	P3321-A	38	FSW	Ball Valve		Flushing Water (W3)	Manual	Vendor	Contractor
	P3-X606	P3321-B	38	FSW	Ball Valve		Flushing Water (W3)	Manual	Vendor	Contractor
	P3-X606	P3321-C	38	FSW	Ball Valve		Flushing Water (W3)	Manual	Vendor	Contractor

VALVE SCHEDULE

Valve Designation			Characteristics				Installed on	Actuator	Supplied by:	Installed by:
Vendor Drawing	AECOM Drawing	Tag No.	Size (mm ND)	Commodity	Process Type	Connect.	Line or Equipment			
	P3-X606	P3321-F	38	FSW	Ball Valve		Flushing Water (W3)	Manual	Vendor	Contractor
	P3-X606	P3321-G	38	SCP	Ball Valve		Scum	Manual	Vendor	Contractor
	P3-X606	XV P33221	25	FSW	Air Actuated Valve		Flushing Water (W3)	Air Actuated	Vendor	Contractor
	P3-X606	XV P33223	25	FSW	Air Actuated Valve		Flushing Water (W3)	Air Actuated	Vendor	Contractor
	P3-X606	XV P33225	25	FSW	Air Actuated Valve		Flushing Water (W3)	Air Actuated	Vendor	Contractor
	P3-X606	P3321-D	75	SCP	Ball Valve		Scum	Manual	Vendor	Contractor
	P3-X606	P3321-E	75	SCP	Ball Valve		Scum	Manual	Vendor	Contractor
	P3-X606	XV P33218	75	SCP	Air Actuated Valve		Scum	Air Actuated	Vendor	Contractor
	P3-X606	XV P33217	75	SCP	Air Actuated Valve		Scum	Air Actuated	Vendor	Contractor
	P3-X606	P3322-A	75	SCP	Ball Valve		Scum	Manual	Vendor	Contractor
	P3-X606	P3322-B	75	SCP	Ball Valve		Scum	Manual	Vendor	Contractor
	P3-X606	P3322-C	75	SCP	Ball Valve		Scum	Manual	Vendor	Contractor
	P3-X606	P3321-H	50	DRA	Ball Valve		Drain	Manual	Contractor	Contractor
	P3-X606	XV P33222	50	FSW	Ball Valve		Flushing Water (W3)	Electrical	Contractor	Contractor
	P3-X606	HV-3423-A	50	FSW	Ball Valve		Flushing Water (W3)	Manual	Contractor	Contractor
	P3-X608	HV-P3410A	12	LCP	Ball Valve		Liquid Polymer	Manual	Vendor	Contractor
	P3-X608	HV-P3411A	12	LCP	Ball Valve		Liquid Polymer	Manual	Vendor	Contractor
	P3-X608	HV-P3411B	12	LCP	Ball Valve		Liquid Polymer	Manual	Vendor	Contractor
	P3-X608	HV-P3412A	12	LCP	Ball Valve		Liquid Polymer	Manual	Vendor	Contractor
	P3-X608	HV-P3412B	12	LCP	Ball Valve		Liquid Polymer	Manual	Vendor	Contractor
	P3-X608	XV P34112	50	MP	Ball Valve		Mixed Polymer	Electrical	Contractor	Contractor
	P3-X608	XV P34122	50	MP	Ball Valve		Mixed Polymer	Electrical	Contractor	Contractor
	P3-X608	HV-P3413A	12	MP	Ball Valve		Mixed Polymer Sample Tap	Manual	Vendor	Contractor
	P3-X608		12	W2	Ball Valve		Potable Water	Manual	Vendor	Contractor
	P3-X608		12	W2	Pressure Regulating Valve		Potable Water	Manual	Vendor	Contractor
	P3-X608	XV P34133	12	W2	Air Actuated Valve		Potable Water	Air Actuated	Vendor	Contractor
	P3-X608	XV P34144	20	W2	SOL		Water (W2)	Solenoid	Contractor	Contractor
	P3-X608	HV-P3413B	50	MP	Ball Valve		Mixed Polymer	Manual	Vendor	Contractor

VALVE SCHEDULE

Valve Designation			Characteristics				Installed on	Actuator	Supplied by:	Installed by:
Vendor Drawing	AECOM Drawing	Tag No.	Size (mm ND)	Commodity	Process Type	Connect.	Line or Equipment			
Odour Control System										
	P5-X601		12	FOA	Ball Valve		Foul Air at Pressure Gauge	Manual	Contractor	Contractor
	P5-X601		12	FOA	Ball Valve		Foul Air at Pressure Gauge	Manual	Contractor	Contractor
	P5-X602	XV P52111	150	FOA	Damper		Foul Air	Electrical	Vendor	Contractor
	P5-X602		12	FOA	Ball Valve		Foul Air at Pressure Gauge	Manual	Vendor	Contractor
	P5-X602		12	FOA	Ball Valve		Foul Air at Pressure Gauge	Manual	Vendor	Contractor
	P5-X602		12	FOA	Ball Valve		Foul Air at Pressure Gauge	Manual	Vendor	Contractor
	P5-X602		12	FOA	Ball Valve		Foul Air at Pressure Gauge	Manual	Vendor	Contractor
	P5-X602	XV P52211	150	FOA	Damper		Foul Air	Electrical	Vendor	Contractor
	P5-X602		12	FOA	Ball Valve		Foul Air at Pressure Gauge	Manual	Vendor	Contractor
	P5-X602		12	FOA	Ball Valve		Foul Air at Pressure Gauge	Manual	Vendor	Contractor
	P5-X602		12	FOA	Ball Valve		Foul Air at Pressure Gauge	Manual	Vendor	Contractor
	P5-X602		12	FOA	Ball Valve		Foul Air at Pressure Gauge	Manual	Vendor	Contractor
	P3-X605	HV-P5140A	150	FOA	Damper		Foul Air	Manual	Contractor	Contractor
	P3-X606	HV-P5140B	150	FOA	Damper		Foul Air	Manual	Contractor	Contractor

VALVE SCHEDULE

Valve Designation			Characteristics				Installed on	Actuator	Supplied by:	Installed by:
Vendor Drawing	AECOM Drawing	Tag No.	Size (mm ND)	Commodity	Process Type	Connect.	Line or Equipment			
Instrumentation Air System										
	P0-X602	HV-P0110-A		IAS	Gate Valve		Instrumentation Air	Manual	Contractor	Contractor
	P0-X602	CV-P0110-A		IAS	Check Valve		Instrumentation Air	Manual	Contractor	Contractor
	P0-X602	HV-P0110-B		IAS	Gate Valve		Instrumentation Air	Manual	Contractor	Contractor
	P0-X602	HV-P0110-C		IAS	Gate Valve		Instrumentation Air	Manual	Contractor	Contractor
	P0-X602	HV-P0110-D		IAS	Gate Valve		Instrumentation Air	Manual	Contractor	Contractor
	P0-X602	HV-P0110-E		IAS	Gate Valve		Instrumentation Air	Manual	Contractor	Contractor
	P0-X602	HV-P0111-B		IAS	Gate Valve		Instrumentation Air	Manual	Contractor	Contractor
	P0-X602	HV-P0111-A		IAS	Gate Valve		Instrumentation Air	Manual	Contractor	Contractor
	P0-X602	HV-P0111-C		IAS	Gate Valve		Instrumentation Air	Manual	Contractor	Contractor
	P0-X602	HV-P0111-D		IAS	Gate Valve		Instrumentation Air	Manual	Contractor	Contractor
	P0-X602	HV-P0111-E		IAS	Gate Valve		Instrumentation Air	Manual	Contractor	Contractor
	P0-X602	HV-P0112-A		IAS	Gate Valve		Instrumentation Air	Manual	Contractor	Contractor
	P0-X602	PRV-P0112-A		IAS	Pressure Regulating Valve		Instrumentation Air	Manual	Contractor	Contractor
	P0-X602	HV-P0120-A		IAS	Gate Valve		Instrumentation Air	Manual	Contractor	Contractor
	P0-X602	CV-P0120-A		IAS	Check Valve		Instrumentation Air	Manual	Contractor	Contractor
	P0-X602	HV-P0120-C		IAS	Gate Valve		Instrumentation Air	Manual	Contractor	Contractor
	P0-X602	HV-P0120-B		IAS	Gate Valve		Instrumentation Air	Manual	Contractor	Contractor
	P0-X602	HV-P0120-D		IAS	Gate Valve		Instrumentation Air	Manual	Contractor	Contractor
	P0-X602	HV-P0120-E		IAS	Gate Valve		Instrumentation Air	Manual	Contractor	Contractor
	P0-X602	HV-P0121-A		IAS	Gate Valve		Instrumentation Air	Manual	Contractor	Contractor
	P0-X602	HV-P0121-B		IAS	Gate Valve		Instrumentation Air	Manual	Contractor	Contractor
	P0-X602	HV-P0121-C		IAS	Gate Valve		Instrumentation Air	Manual	Contractor	Contractor
	P0-X602	HV-P0121-D		IAS	Gate Valve		Instrumentation Air	Manual	Contractor	Contractor
	P0-X602	HV-P0121-E		IAS	Gate Valve		Instrumentation Air	Manual	Contractor	Contractor
	P0-X602	HV-P0132-A		IAS	Gate Valve		Instrumentation Air	Manual	Contractor	Contractor
	P0-X602	PRV-P0132-A		IAS	Pressure Regulating Valve		Instrumentation Air	Manual	Contractor	Contractor
	P0-X602	HV-P0115-D		IAS	Gate Valve		Instrumentation Air	Manual	Contractor	Contractor
	P0-X602	HV-P0122-A		IAS	Gate Valve		Instrumentation Air	Manual	Contractor	Contractor
	P0-X602	PRV-P0122-A		IAS	Pressure Regulating Valve		Instrumentation Air	Manual	Contractor	Contractor
	P0-X602	CV-P0110-B		IAS	Check Valve		Instrumentation Air	Manual	Contractor	Contractor
	P0-X602	CV-P0120-B		IAS	Check Valve		Instrumentation Air	Manual	Contractor	Contractor
END OF SECTION										

PROCESS PIPE EXPANSION JOINTS

1. GENERAL

1.1 Description

.1 This Section describes process expansion joint supply and methods for installation.

.2 Refer to the general piping requirements of Section 40 05 13. Use the general requirements specified in this Section and Section 40 05 13.

.3 Construction Contractor to provide a complete piping system design as described in Section 40 05 13.

1.2 Submittals

.1 Refer to Section 01 33 00.

.2 With the submittals required in Section 40 05 13, provide a listing of the expansion joints used in the performance of the Work.

.3 Provide Shop Drawings showing expansion joint details including maximum allowable temperature and pressure rating, overall face-to-face length measured at 15°C, wall thickness, number of convolutions per joint, spring rate, maximum allowable axial, lateral and angular movement and materials of construction.

1.3 Coordination

.1 Coordinate the expansion joints with the final piping requirements and ensure that the connection techniques match.

1.4 Quality Assurance

.1 Comply with the requirements of Expansion Joint Manufacturers Association (EJMA).

1.5 Shipment, Protection and Storage

.1 Refer to Section 40 05 13 for Shipment and Storage.

.2 Provide shipping and installation blocking to prevent over-extension and deflection. Remove blocks prior to leak testing.

2. PRODUCTS

2.1 Function

.1 Expansion joints are used to compensate for thermal expansion and contraction in the piping system; to isolate equipment from stresses and vibration transmitted from the piping system; and to allow for seismic or long term settlement which could cause differential movement in adjacent piping or equipment.

.2 Design and fabricate expansion joints in accordance with EJMA standards and to meet the requirements of this Section.

.3 Provide expansion joints as necessary to allow for piping expansion and contraction. Unless otherwise specified provide elastomer, spherical moulded type expansion joints.

2.2 Elastomer Expansion Joints

.1 Select materials suitable for service commodity, temperature and pressure. Conform to the requirements of the Fluid Sealing Association, Rubber Expansion Joint Division.

.2 Provide control rods on expansion joint connectors to prevent excessive axial elongation and to accept the static pressure thrust in the piping system. Manufacturer to determine number and sizes of control rods.

.3 Provide elastomer cover of the same material as the elastomer tube liner.

.1 For service temperatures between minus 40°C and 120°C, use EPDM for the elastomer tube.

.4 Elastomer, Spool Type:

.1 Unless otherwise specified, provide spool, resilient arch type expansion joints.

.2 Construct of multiple plies of woven fabric impregnated with elastomer and reinforced with steel rings or wire embedded in the body.

.3 Provide backup or retaining rings of galvanized steel construction. Make retaining rings a nominal 10 mm thick, split type.

.4 Use filled arch type expansion joints on all piping systems conveying fluids containing solids.

2.3 Sliding Joints - Liquid Service

.1 Provide single end type sliding expansion joints able to allow longitudinal movement and radial stresses while maintaining pipe alignment. Provide through rods where necessary to maintain alignment.

.2 Limit longitudinal separation of the two pipe sections to 50% of the Manufacturer's recommended maximum by a restraining flange affixed to the slip pipe with the bolts extending through this flange.

.3 Use packing material suitable for the service conditions.

2.4 Flexible Hose Connectors

.1 Where other types of flexible expansion joints are not shown or specified, provide flexible hose connectors within 2 m pipe length of rotating equipment suction, discharge and ancillary service connection.

.2 Provide flexible hose connectors with live lengths suitable for a line pressure equal to the test pressure of the pipe and for 12.5 mm lateral movement each side of the pipe centerline.

.3 Provide one union for pipe diameters <65 mm or floating flange for pipe diameter >65 mm, per flexible connector as appropriate to minimize the possibility of torque damage during installation.

.4 Provide flexible hose connectors capable of minimum of 10,000 cycles at the Manufacturer's published minimum intermittent centreline bend radius and maximum working pressure.

.5 The design standard for flexible hose connectors on piping systems up to and including 75 mm diameter is Senior Flexonics Type UFBX annular corrugated hose connectors.

.6 The design standard for flexible hose connectors on piping systems larger than 75 mm diameter is Senior Flexonics Type of 301 corrugated flexible metal hose connectors.

2.5 Acceptable Manufacturer

.1 Robar.

.2 Romac.

.3 Senior Flexonics Canada Ltd.

.4 Proco.

.5 Approved equals.

3. EXECUTION

3.1 Expansion Joints

.1 Accurately align pipelines to receive expansion joints before installing the joint. Do not stretch, compress or offset the joint to fit the piping.

.2 Align and install each expansion joint in accordance with EJMA standards and with the Manufacturer's written instruction, properly guide and anchor all expansion joints. No lateral movement is permitted on compensator type expansion joints.

.3 Pre-compress expansion joint as required depending on installation temperature.

.4 On rubber expansion joints, check bolt tightness, and tighten where necessary one (1) week after commissioning.

3.2 Flexible Hose Connectors

.1 Accurately align pipelines to receive flexible connectors before installing the connectors. Do not stretch, compress, misalign or offset the connectors.

.2 Align and install each flexible connector in accordance with the Manufacturer's instructions.

.3 Support, anchor and guide the piping so that the flexible connectors are not required to absorb any axial compression or elongation.

.4 Do not torque or twist the flexible connectors.

.5 Check bolt tightness and tighten where necessary, a maximum of one (1) week after commissioning and periodically thereafter.

END OF SECTION

PROCESS PIPELINE APPURTENANCES

1. GENERAL

1.1 Description

.1 This Section describes process pipeline appurtenances installed integrally with the piping.

.2 Refer to the general piping requirements of Section 40 05 13 Use the general requirements specified in this Section and Section 40 05 13.

1.2 Submittals

.1 Provide Shop Drawings for each type of pipeline appurtenance in accordance with the requirements of Sections 01 33 00 and 40 05 13.

.2 Show the materials of construction, a cutout indicating the interior workings of the unit, and illustrations of the method of installation.

1.3 Coordination

.1 Coordinate the appurtenances with the piping final layout and arrangement. Ensure that the appurtenances are mounted in locations suitable for their intended function and are accessible for maintenance.

1.4 Quality Assurance

.1 Refer to Section 40 05 13 for welding quality assurance requirements.

2. PRODUCTS

2.1 Function

.1 Provide the pipe appurtenances as described below, for the piping systems shown.

2.2 Strainers

.1 Air Strainers:

.1 Provide strainers with Y-pattern, cast iron body, with 40 mesh Moel screens packed with Everdur wool.

.2 Fit air line strainers with a brass blow-off cock.

.2 Chemical Strainers:

.1 Provide Y-pattern chemical strainers with a PVC body.

.2 Provide PVC Filter Screen with 0.8 mm screen perforations.

.3 Provide tapped and plugged blowoff connections.

2.3 Quick Disconnects

.1 Provide quick disconnects which are not disconnectable under pressure. Unless otherwise shown or specified, provide products listed below.

.2 For water service, provide products to the City standard; two-lug, malleable iron, female NPT. Sizes as shown.

2.4 Flushing Connections

.1 Provide flushing connections on all piping for the conveyance of sludge, scum, grit or other liquid containing solids greater than 0.5%.

.2 Locate flushing connections adjacent to all isolation valves, on dead end branches, at tees and 90 degree elbows, and at intermediate locations which limit the distance between flushing connections to less than 30 m.

.3 Show flushing connections on piping submittals.

2.5 Mechanical Branch Connections

.1 Provide mechanical branch connections as required for flushing connections and pipe tappings as shown in the Standard Details.

.2 Provide branch connection recommended by the Manufacturer for the service and pipe installed.

2.6 Hoses

.1 Provide hoses rated for 600 kPa, complete with quick connect fittings as per standard details and as called for on the general arrangement drawings.

3. EXECUTION

3.1 Pipeline Appurtenances

.1 Provide manual air vents at the high points of each reach of pipeline and where shown, consisting of a ball valve and PVC tubing return. Take air vents to the nearest floor with the valve mounted in a location accessible from floor level and no greater than 1.2 m above the floor. For piping systems conveying fluids containing solids, use 25 mm line with a non-lubricated ball valve fitted with quick disconnects. For a high point vent required on an extended run of constant elevation pipe, locate the vent at the downstream end of the run close to the downward elbow.

.2 Provide manual drains at the low point of each reach of pipeline and where shown to allow complete draining of all pipework. Pipe drains to a sump, gutter, floor drain, or other collection point with a valve mounted in a location accessible from floor level and no greater than 1.2 m above the floor. Provide threaded ball valves for drain valves of the size shown. When drains cannot be run to collection points, route them to a point of easy access and attach quick disconnects of the size specified. For pumps that do not come with integral drains, provide 25 mm drain connections with threaded manual ball valves inside pump isolation valves.

.3 Unless otherwise shown or specified, install gauge taps on the suction and discharge of all pumps, fans, blowers, compressors, and vacuum pumps. Attach gauge taps with a threaded nipple and valve, as shown, attached by a threaded nipple to the pipeline, duct or equipment.

.4 Install flushing and purge connections as described in Part 2 and as shown. Install sample lines and connections as shown.

3.2 Testing

.1 Give the Contract Administrator twenty-four (24) hours notice prior to testing.

.2 Do not insulate or conceal work until piping systems are tested and accepted.

.3 Complete any required weld tests.

.4 Supply all water, air and inert gases required for pressure testing.

.5 Supply all pumps, compressors, gauges, etc. required for testing.

.6 Install air threadolets, air relief valves and line fitting valves as necessary to complete testing. Remove after testing and plug the threadolets.

.7 Cap or plug all lines which are normally open ended. Remove on completion of testing.

.8 Provide all temporary thrust restraints necessary for testing. Remove upon completion of testing.

.9 Test all underground lines prior to backfilling. Do not place concrete surround until lines are tested.

.10 Test all existing piping where it connects to new piping to the first valve in the existing piping. Repair any failures in existing piping which occur as a result of the test after informing the Contract Administrator of such failure.

.11 Isolate all low pressure equipment and appurtenances during testing so as not to place any excess pressure on the operating equipment.

.12 Where defective material or equipment is identified, repair or replace using new material.

.13 Flush and drain liquid pipes after pressure tests. Purge all gas pipes after pressure tests.

.14 Dispose of flushing water in manner approved by the Contract Administrator, which causes no damage to buildings or siteworks.

3.3 Pressure Testing of Gas, Air and Vapour Lines

.1 Hydrostatically or pneumatically pressure test, as shown in the table below, all lines normally used for the conveyance of gas, air, and/or vapour in accordance with ASME procedures for testing pressure piping and CAN/CGA B105 for buried digester gas piping. Pneumatically test all instrument air lines in accordance with ISA-RP7.1.

.2 For gas and air lines to be hydrostatically tested, check support system to ensure it is capable of withstanding loads imparted by test method. Provide any additional supports necessary in a manner acceptable to the Contract Administrator. At the Contract Administrator's request, provide calculations indicating design of temporary support system.

.3 Other than for chlorine and sulphur dioxide piping systems, use the following test medium.

Pipe Size	Specified Testing	Medium Test Pressure
50 mm and smaller	500 kPa or less	Air or water
50 mm and smaller	Greater than 500 kPa	Water
Greater than 50 mm	500 kPa or less	Air or water
Greater than 50 mm	Greater than 500 kPa	Water

.4 Test pressures to be confirmed by the Contract Administrator.

.5 Zero leakage rate for insulated systems, and systems tested with water is required at the specified test pressure through the test period. Prior to commencing test using air, ensure air will be at ambient temperature and specified test pressure.

.6 Do not exceed 5% of the specified test pressure as the allowable leakage rate over the test period for other systems tested with air.

.7 Wet all joints using a mixture of soap and water in systems tested with air. Remake all joints which display leakage and retest.

.8 Test natural gas piping in accordance with CAN/CSA B139.

3.4 Cleaning and Flushing

.1 After installation and prior to testing, perform initial cleaning of process and utility lines. Clean piping greater than 150 mm and less than 600 mm by passing a tightly fitting cleaning ball or swab through the pipeline, unless specified otherwise. Lines greater than 600 mm may be cleaned manually or with a cleaning ball or swab. Give lines smaller or equal to 150 mm an initial flush or purge.

.2 After initial cleaning, connect the piping systems to related process and mechanical equipment. Insert temporary screens, provided with visible locator tabs, in the suction of pumps and compressors in accordance with the following table:

Suction Diameter (mm)	Maximum Screen Opening (mm)
0 - 25	1.5
30-75	6.25
80-150	12.5
>150	25

.3 Maintain the screens during testing, flushing/purging, initial start-up, and the initial operating phases of the commissioning process. In special cases and with the Contract Administrator's acceptance, screens may be removed for performance tests.

.4 Unless specified otherwise, flush liquid systems after testing, with clean water and screens in place. Maintain flushing for a minimum period of fifteen (15) minutes and until no debris is collected in the screens.

.5 In air or gas systems with pipe sizes less than or equal to 150 mm, purge with air and/or inert gases before testing. Upon completion of testing and cleaning, drain and dry the piping with a dry air stream. Satisfy ANSI/ISA-S7.3 standards for instrument air systems.

.6 Brush clean steel pipe exterior to SSPC-P3 standard prior to painting.

END OF SECTION

PROCESS PIPE HANGERS AND SUPPORTS

1. GENERAL

1.1 Work Included

.1 Supply and installation of hangers and supports for all process piping systems specified in Section 40 05 13.

.2 Engage a Professional Engineer Registered in the Province of Manitoba to be responsible for the final aspects of the piping support system design, including details and spacing of all supports. The support system will ensure that the weight of the pipework and the need for lateral and vertical support are considered fully. Construction Contractor to provide a complete piping system design as described in Section 40 05 13.

1.2 Submissions

.1 Submit the following for information in accordance with Section 01 33 00:

.1 Indicate hanger and support locations and provide legend summarizing load information and hanger and support component selection at each location.

1.3 Service Conditions

.1 Construction Contractor is responsible for the design and supply of a complete and adequate support system.

.2 Provide hangers and supports specified in this Section to resist pipe loads occurring primarily in the downward (gravity) direction. For the purpose of pipe hanger and support selection, this Section established pipe support classifications based on the operating temperature of the piping contents.

.3 Pipe support classifications:

.1 Ambient systems:

.1 B-1: 15-49°C.

.2 Cold systems:

.1 C-1: 0.5-15°C.

.2 C-2: minus 40-0°C.

1.4 Hanger and Support Selection

.1 Piping supports are generally not shown on the process or mechanical layout Drawings. Therefore, select pipe hangers and supports as specified in this Section. Typical support details and structural attachments shown on the Drawings indicate the level of quality that will be considered acceptable. Where specific supports are illustrated on the process mechanical or structural Drawings or where a specific standard detail is noted on the Drawings, provide that type of support for that particular pipeline.

.2 Review the final piping layout in relation to the surrounding structure and adjacent piping and equipment before selecting the type of support to be used at each hanger point.

.3 Hangers and supports shall withstand all static and specified dynamic conditions of loading to which the piping and associated equipment may be subjected. As a minimum, consideration shall be given to following conditions:

.1 Water fill piping has dynamic loads caused by the hauling vehicle.

.2 Weights of pipe, valves, fitting, insulating materials, suspended hanger components, and normal fluid contents.

.3 Weight of hydrostatic test fluid or cleaning fluid if normal operating fluid contents are lighter.

.4 Reaction forces due to the operation of safety or relief valves.

.5 Wind, snow, or ice loadings on outdoor piping.

.4 Size hangers and supports to fit the outside diameter of pipe, tubing, or where specified, the outside diameter of insulation.

.5 Where negligible movement occurs at hanger locations, use rod hangers for suspended lines, whenever practical. Use bases, brackets, or structural cross members for piping supported from below.

.6 Hangers for the suspension of pipe and tubing sizes 65 mm and larger shall be capable of vertical hanger component adjustment under load.

.7 Provide the supporting systems to allow for free or intended movement of the piping including its movement in relation to that of connected equipment.

.8 Design the system to support the operating loads with a safety factor of 4.0.

.9 Where there is horizontal movement at a suspended type hanger location, select hanger components to allow for swing. The vertical angle of the hanger rod shall not, at any time, exceed 4°.

.10 No contact is allowed between a pipe and hanger or support components of dissimilar metals. Prevent contact between dissimilar metals when supporting copper tubing with copper-plated, rubber, plastic, or vinyl coated, or stainless steel hanger and support components.

.11 Do not support piping from masonry wall construction.

.12 Do not use existing pipes and supports to support new piping unless otherwise specified.

.13 Do not attach pipe support components to equipment or pressure vessels unless otherwise specified.

.14 Use stock hanger and support components wherever practical.

.15 Provide supplementary structural members, where structural bearings are not in suitable locations.

.1 Make provision for expansion, contraction, slope, and anchorage.

.2 Where necessary, pipe support systems shall withstand the additional load of electrical or instrumentation trays. Coordinate with other Divisions. Design and provide support system accordingly.

2. PRODUCTS

2.1 SUPPORT SPACING

.1 Maximum support spacing shall be as listed in the following table:

Pipe Size Nominal (mm)	Maximum Spacing (m)	
	PVC	Stainless Steel
30 and under	1.4	2.1
30 to 40	1.5	2.1
40 to 50	1.6	2.1
60 to 75	1.8	3.0
100	1.5	3.7
150	2.0	4.3
200	3.5	4.6
250	4.0	4.9
300	4.5	5.2
350	4.5	5.8
400	4.5	6.1
500	4.5	6.7
600 and greater	4.5	6.7

.2 Provide additional supports at any valves or other heavy piping element.

2.2 Materials

.1 In Building, Exterior, Submerged or Corrosive Environments:

.1 Pipe hangers, supports, structural attachments, fittings, accessories and hardware are all stainless steel.

.2 Provide AISI, type 316 stainless steel materials.

2.3 Pipe Hangers and Supports

.1 Provide bracing, hangers and support for the screening system conveyor based on Huber recommendation (manufacturer of the Novated Equipment)

.2 Type 1 - Clevis Pipe Hanger: provide 316SS clevis hangers with configuration and components as follows:

.1 Steel pipe (insulated) - B-Line B3100, Grinnell Figure 260, Superstrut C-710 or Unistrut No. 24 with insulation shield.

.2 Steel pipe (uninsulated) - B-Line B3100, Grinnell Figure 260, Superstrut C-710 or Unistrut No. 24.

.3 Cast and ductile iron pipe - B-Line B3102, Grinnell Figure 590, Superstrut C-710 or Unistrut No. 24.

.4 Copper pipe (uninsulated) - shall be B-Line B3104 CT, Grinnell Figure CT-65, Superstrut C-710 or Unistrut No. 51.

.5 Copper pipe (insulated) - B-Line B3100, Grinnell Figure 260, Superstrut C-710 or Unistrut No. 24, with insulation shield.

.6 Plastic pipe - B-Line B3100, Grinnell Figure 260 or Unistrut No. 56.

.3 Type 2 - "J" Pipe Hanger: provide 316SS hangers with configuration and components equivalent to MSS Type 5. Use only on uninsulated pipe, with configuration and components as follows:

.1 Steel pipe - B-Line B3690, Grinnell Figure 67, Superstrut C-711 or Unistrut J1205-J1280 Series.

.2 Copper and plastic pipe - B-Line B3690 (Plasticoat) Grinnell Figure 67 (plastic coated), Superstrut C-711P or Unistrut J 1205N-J1280N series.

.4 Type 3 - Double Bolt Pipe Clamp: Provide 316SS pipe clamps, with configuration and components as follows:

.1 Steel pipe (insulated) - B-Line B3144 or Grinnell Figure 295, with insulation shield. Insulation shield is optional for hot and ambient systems.

.2 Steel pipe (uninsulated - B-Line B3144 or Grinnell Figure 295.

.3 Copper pipe (insulated only) - B-Line 3144 or Grinnell Figure 295, with insulation shield.

.5 Type 4 - Adjustable Roller Hanger: Provide cast iron rollers, 316SS yoke and cross bolt with configuration and components as follows:

.1 Stainless steel pipe (insulated) - B-Line B3110, Grinnell Figure 181 or Superstrut C-729, with insulation shield.

.2 Stainless steel pipe (uninsulated) - B-Line B3110, Grinnell Figure 181 or Superstrut C-729.

.3 Plastic pipe - B-Line B3110, Grinnell Figure 181 or Superstrut C-729.

.6 Type 5 - Single Pipe Roll: Provide cast iron rollers and sockets, and steel cross rods with configuration and components as follows:

.1 Stainless steel pipe (insulated) - B-Line B3114, Grinnell Figure 171 with insulation shield.

.2 Stainless steel pipe (uninsulated) - B-Line B3114, Grinnell Figure 171.

.3 Plastic pipe - B-Line B3114, Grinnell Figure 171.

.7 Type 6 - Framing Channel Pipe Clamp: Provide stainless steel pipe clamps as listed below:

.1 Stainless steel pipe (uninsulated) - B-Line 2007, Powerstrut PS1100, or Unistrut P1009 Series:

Pipe Diameter (mm)	Thickness (mm)
10 and 12	1.6
20 to 32	2.0
38 to 75	2.8
90 to 125	3.2
150 to 200	3.6

.2 Stainless steel pipe (insulated) with insulation shield.

.3 Copper (uninsulated) and plastic pipe, B-Line B2033 Series, Powerstrut PS1200 or Unistrut P2024C and P2024PC Series B-Line. Provide a copper-plated, plastic coated or lined with a dielectric material on pipe clamps.

Pipe Diameter (mm)	Thickness (mm)
10 to 25	1.6
32 and 38	2.0
50 to 75	2.8
100	3.2

.8 Type 7 - U-Bolt: Provide 316SS U-bolts with configuration as follows:

.1 Plastic pipe - Anvil Figure 137C, B-Line B3188.

.9 Type 8 - Adjustable Pipe Roll Support: Provide cast iron rollers and sockets, and stainless steel cross rod and support rods with configuration and components as follows:

.1 Stainless steel pipe (insulated) - B-Line B3122 or Grinnell Figure 177 with insulation shield.

.2 Stainless steel pipe (uninsulated) - B-Line B3122 or Grinnell Figure 177.

.3 Plastic pipe - B-Line B3122 or Grinnell Figure 177.

.10 Type 9 - Welded Pipe Stanchion: Provide a 316SS, standard schedule pipe stanchion, cut pipe to match contour of pipe elbow. Use only for ambient commodity systems.

.11 Type 10 - Pipe Stanchion saddle: provide 316SS saddles and yokes as follows:

.1 Stainless steel pipe (insulated) - B-Line B3900 or Grinnell Figure 259 with insulation shield.

.2 Stainless steel pipe (uninsulated) - B-Line 3090 or Grinnell Figure 259.

.3 Plastic pipe - B-Line B3090 or Grinnell Figure 259.

.12 Type 11 - Offset Pipe Clamp: provide 316SS pipe clamps with configuration and components as specified and to the most standard design manufactured by a pipe hanger component manufacturer:

.1 Stainless steel pipe (insulated) - B-Line B3148 or Grinnell Figure 103 or with insulation shield.

.2 Stainless steel pipe (uninsulated) - B-Line B3148 or Grinnell Figure 103.

.3 Plastic pipe - B-Line B3148 or Grinnell Figure 103.

.13 Type 12 - Riser Clamp: provide stainless steel riser clamps with configuration and components as follows:

.1 Stainless steel pipe (insulated) - B-Line B3373 or Grinnell Figure 261, Superstrut C-720 or Unistrut No. 82.

.2 Stainless steel pipe (uninsulated) - B-Line B3373 or Grinnell Figure 261, Superstrut C-720 or Unistrut No. 82.

.3 Plastic pipe - B-Line B3373, Grinnell Figure 261C, or Superstrut C-720 or Unistrut No. 82.

.14 Type 13 - Framing Channel Pipe Strap: provide 316SS pipe strap with configuration as follows:

.1 Stainless steel pipe (uninsulated) - B-Line B2400 Series, Powerstrut PS3126, Superstrut C-708-U or Unistrut P2008 Series.

.2 Stainless steel pipe (insulated) - B-Line B2400 Series, Powerstrut PS3126, Superstrut C-708-U or Unistrut P2008 Series with insulation shield.

.3 Plastic pipe - B-Line B2400 Series, Powerstrut PS3126, Superstrut C-708-U or Unistrut P2008 Series.

.15 Rack and Trapeze Supports:

.1 Unless otherwise specified, provide steel trapeze and pipe rack components having a minimum thickness of 2.8 mm with a maximum deflection 1/240 of the span. Framing channel as specified in 2.4.16.5.

.2 Type 20 - Trapeze Pipe Support: Trapeze pipe support cross members as specified in 2.4.16.5. Provide 41 mm^2 carbon steel flat plate fittings of stranded design manufactured by framing channel manufacturer, B-Line B202-2, Powerstrut PS619 or Unistrut P1062 Series.

.3 Type 21 - Pipe Rack Support: Post and cross member framing channels, as specified in 2.4.16.5. Provide carbon steel pipe rack fittings of standard design manufactured by framing channel manufacturer. Provide gusset type, 90° fittings, B-Line B844, Grinnell PS3373 or Unistrut P2484. Post base fittings as specified in 2.3.16.14.

.16 Structural Attachments:

.1 Type A - Malleable Iron Concrete Insert: Provide 316SS concrete inserts; B-Line B3014, Grinnell Figure 282 or Unistrut M2808.

.2 Type B - Side Beam Bracket: Provide 316SS bracket; Grinnell Figure 202 or B-Line B3062.

.3 Type C - 316SS Clamp With Extension Piece: Provide 316SS clamp and extension pieces with steel tie rods; Grinnell Figure 218 with Figure 157 extension piece or B-Line B3054.

.4 Type D - 316SS Beam Clamp With Eye Nut: Provide 316SS beam clamps and eye nuts; Grinnell Figure 292, B-Line B3291 series.

.5 Type E - Steel channel clamp: Provide 316SS clamp and heel plates, and 316SS bolts and nuts; Grinnell Figure 226.

.6 Type F - Welded Beam Attachment: Provide 316SS beam attachments; B-Line B3083 or Grinnell Figure 66.

.7 Type G - Adjustable Beam Attachment: Provide 316SS beam attachments, B-Line B3082, Unistrut P1737 or Powerstrut PS2648.

.8 Type H - Double Channel Bracket: Provide single channel attachment as specified in 2.4.16.5. Provide a 316SS double framing channel cantilever bracket assembly; B-Line B297-12 through B297-36, Powerstrut PS809 or Unistrut P2542 series.

.9 Type J - Single Channel Bracket: Provide single channel attachment as specified in 2.4.16.5. Provide a 316SS single framing channel cantilever bracket assembly; B-Line B198-6 through B198-24, Powerstrut PS661 or Unistrut P2231 through P2234.

.10 Type K - Wall Mounted Channel: Provide 41 mm x 62 mm 316SS framing channel; B-Line B12 or Unistrut P5500.

.11 Type L - Pipe Stanchion Attachment: Provide minimum 12 mm thick 316SS baseplate. Anchor bolt holes: 1.6 mm larger than bolt diameter. Provide non-shrink grout between the baseplate and upstand.

.12 Type M - Welded Steel Bracket: Provide 316SS brackets which comply with MSS Type 32 and FEDSPEC Type 33 for medium welded bracket: Grinnell Figure 195. Heavy welded bracket to comply with MSS Type 33 and FEDSPEC Type 34; Grinnell Figure 199.

.13 Type N - Cast Iron Bracket: Provide cast iron brackets; Grinnell Figure 213.

.14 Type P - Framing Channel Post Base: Provide 316SS post bases of stranded design manufactured by framing channel manufacture. Single channel: Unistrut P2072A, B-Line B280 Powerstrut PS3025. Double channel: Unistrut P2073A, B-Line B281 or Powerstrut PS3064.

.15 Type Q - Continuous Concrete Inserts: Provide 300 mm long 316SS concrete inserts; Unistrut P3253.

.17 Accessories:

.1 Weldless Eye Nut: Provide forged steel eye nuts and comply with MSS and FEDSPEC Type 17; Grinnell Figure 290 or B-Line B3200.

.2 Welded Eye Rod: Provide 316SS eye rods with eye welded closed. Inside diameter of eye to accommodate a bolt diameter 3.2 mm larger than the rod diameter; Grinnell Figure 278 or B-Line B3211.

.3 Turnbuckle: Provide 316SS turnbuckles; Grinnell Figure 230 or B-Line B3202.

.4 Framing Channels: Provide 41 mm x 62 mm roll formed 316SS framed channel, having a thickness of 2.7 mm. Channel to have a continuous slot along one side with in-turned clamping ridges. Single Channel: Unistrut P5500. Double Channel: Unistrut P5501.

.5 Anchor bolts to Division 5.

2.4 Hanger Rods

.1 Rod material shall conform to ASTM A307 as a minimum, and shall be cadmium plated in non-corrosive interior spaces, threaded on both ends or continuous threaded and sized as specified.

.2 Hanger rod dimensions, as a minimum shall be as follows:

Pipe Size Nominal (mm)	Hanger Rod (mm)
50	10
75	12
100	16
150	20
200	22
250	25
300	25
400	29
500	38
600	44

2.5 Base Elbows

.1 Where elbows change the run of a horizontal pipe to a vertical direction, supports shall be secured to the elbow.

.2 Dimensions for the supports shall be as follows:

Pipe Size		
Support Pipe Nominal (mm)	**Diameter (mm)**	**Base Plate (mm x mm)**
100	50 Schedule 40	100 x 6
150	75 Schedule 40	125 x 6
200	100 Schedule 40	150 x 6
250	100 Schedule 40	150 x 6
300	150 Schedule 40	200 x 10
350	200 Schedule 40	250 x 10
400	200 Schedule 40	250 x 10
500	250 Standard Weight	300 x 10
600	300 Standard Weight	350 x 10
750	350 Standard Weight	400 x 10
1050	350 Standard Weight	400 x 10

.3 Gauge piping: in general, support elbow stanchions for gauge stainless steel piping shall be of the same diameter as the pipe.

3. EXECUTION

3.1 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 1000 mm 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, tanks, 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.

3.2 Installation

.1 Welded and bolted attachments to the building structural steel to be in accordance with the requirements of Division 5. Unless otherwise specified, do not drill or burn holes in the building structural steel.

.2 Do not use hanger components for purposes other than for which they were designed. Do not use hanger components for rigging and erection purposes.

.3 Install items to be embedded before concrete is poured. Fasten embedded items securely to prevent movement when concrete is poured.

.4 Install thermal pipe hanger shields on insulated piping at required locations during hanger and support installation. Butt joint connections to pipe insulation shall be made at the tie of insulation installation in accordance with the Manufacturer's recommendation.

.5 All minor modifications to accommodate installed equipment and structural components are subject to review. Do not commence Work on related piping until written acceptance has been received.

.6 Include any piping support modifications on the Shop Drawings submitted prior to fabrication or installation.

.7 Prior to installation, inspect and field measure to ensure that previous Work is not prejudicial to the proper installation of piping.

.8 Hanger and support components in contact with plastic pipe shall be free of burrs and sharp edges.

.9 Finished floor beneath Type L structural attachments and framing channel post bases shall be roughed prior to grouting. Grout between base plate and floor shall be free of voids or foreign material.

.10 Cut and drill base plates to specified dimensions prior to welding stanchions or other attachments and prior to setting anchor bolts.

.11 Provide plastic or rubber end caps at the exposed ends of all framing channels that are located up to 2100 mm above the floor.

.12 Review the Drawings prior to installation of piping, conduit, and fixtures by this or any other Division. Identify any conflicts and confirm the routing of each section of pipe prior to commencement of installation. Advise of any conflicts with existing services. Where necessary, amend the routing of pipework to avoid conflict and provide Shop Drawings showing proposed routing.

3.3 Adjustment

.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 Under Slab Piping

.1 The Construction Contractor is to note that long term settlement is expected to varying degrees below most of the structural slabs and tanks.

.2 Maximum support spacing shall be as listed in the following table:

Pipe Size Nominal (mm)	Maximum Spacing (m)	
	PVC	Stainless Steel
30 and under	0.7	1.05
30 to 40	0.75	1
40 to 50	0.8	1
60 to 75	0.9	1.5
100	0.75	1.85
150	1	2.2
200	1.7	2.3
250	2	2.4
300	2.25	2.6
350	2.25	2.9
400	2.25	3.05
500	2.25	3.35
600 and greater	2.25	3.35

END OF SECTION

ELECTRIC MOTOR ACTUATORS AND APPURTENANCES

1. GENERAL

1.1 References

.1 The following standards are reference for this section:

.1 International Standards Organization (ISO):

.1 5210, Industrial Valves – Multi Turn Actuator Attachment.

.2 5211, Industrial Valves – Part Turn Actuator Attachment.

.2 National Electrical Manufacturers Association (NEMA).

.3 Underwriters Laboratory (UL):

.1 1709, UL Standard for Safety, Rapid Rise Fire Tests of Protection Materials for Structural Steel.

1.2 Work Included

.1 Supply, installation and testing of electric powered actuators and accessories for controlled devices such as valves, gates, dampers, etc.

.2 Sizing and selection of modulating control valve and actuator components.

.3 Coordinate with the valve, gate, or damper supplier to size and match powered actuators to controlled devices.

1.3 Submittals

.1 Submit Shop Drawings for complete actuator assemblies and accessories prior to delivery. Submittals to include.

.1 Product data sheets for each make and model. Indicate valve Type Number, applicable Tag Number, and facility name/number or service where used.

.2 Complete catalog information, descriptive literature, specifications, identification of materials of construction, and cross-sectional details.

.3 Submit the following data complete, grouped together, and separated by divider, for each set of valves with the same combination of features and accessories:

.1 Dimensional outline drawing showing valve body, trim, actuator, and accessories.

.2 Identification of materials of construction, cross-sectional views and details; for valves, components, and accessories.

.3 Power and control wiring diagrams, including terminals and numbers.

.4 Complete motor nameplate data.

.5 Sizing calculations for open-close, throttling and modulating valves.

.6 Valve pressure and temperature ratings.

.7 List of Configuration Parameters: Include the following for each piece of equipment and/or component which contains adjustable or programmable settings:

.1 List of switchable settings, or programmable settings complete with:

.1 Switch/parameter tag No. or I.D. or address.

.2 Range of possible settings.

.3 Factory default setting.

.4 Blank column for recording final field setting.

.2 Description of each adjustable parameter complete with description of each allowable value.

.2 Manufacturer's Certificate of Compliance in accordance with Section 01 79 00, Contractor Field Services for tests and inspection data.

.3 Manufacturer's Certificate of Proper Installation in accordance with Section 01 43 33, Contractor Field Services.

.4 Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.

.5 Submit a completed ISA S20.50 Instrument Specification Sheet for each device.

1.4 Service Conditions

.1 Provide electrical enclosures rated for the area classification.

.2 Coordinate with designer for process and design conditions.

1.5 Shipment, Protection and Storage

.1 Ship and store equipment in accordance with Division 1.

1.6 Delivery and Storage

.1 Deliver valves and actuators to site using loading methods which will not damage casings or coatings.

.2 Clearly tag all control valves and actuators, stating size, type, coatings and mating parts.

.3 When stored on-site, use storage methods recommended by the Manufacturer to prevent damage, undue stresses and protection from adverse weather conditions.

2. PRODUCTS

2.1 General

.1 Provide new material only.

.2 Provide all actuator mounting hardware and accessories mounted on the device prior to shipment.

.3 Provide actuators of NEMA 4X construction or better, suitable for use in an industrial environment. Provide hazardous area approvals where required for classified areas.

.4 Provide device and actuator as a matched set from the same supplier or manufacturer wherever possible.

.5 Size operators and actuators to operate valve for the full range of pressures and velocities.

.6 Size actuators for drip-tight shutoff and breakaway at full valve pressure rating, unless otherwise specified.

.7 Tag the control devices, accessories and actuators to indicate operating characteristics. Tag the actuator inlet and outlet ports for electric services. Electric actuators must be CSA or cUL approved.

2.2 Actuator Types

.1 Manual Operator:

.1 General:

.1 Operator force not to exceed 178 N under any operating condition, including initial breakaway. Gear reduction operator when force exceeds 178 N.

.2 Operator self-locking type or equipped with self-locking device.

.3 Position indicator on quarter-turn valves.

.2 Operator:

.1 Galvanized or painted handwheel.

.2 Lever operator allowed on quarter-turn valves 100 mm and smaller.

.3 Crank on gear type operators.

.4 Chain wheel operator with tiebacks, extension stem, floor stands, and other accessories to permit operation from normal operation level.

.5 Valve handles to take a padlock, and wheels a chain and padlock.

.2 Electric Motor Actuators - Single Phase:

.1 General:

.1 Use only when specifically permitted in the Electric Motor Actuated Valve Schedule.

.2 Full 90-degree rotation of quarter-turn valves.

.3 Suitable for the area classification.

.4 Valve shall remain in last position on loss of operator power unless indicated otherwise.

.2 Actuator shall be sized to provide torque required to operate valve at 90 percent of nominal voltage.

.3 The required fuse protection size is not to exceed 5A Time Delay.

.4 Actuator Power Supply: 120V ac, single-phase, 60 Hz unless indicated otherwise.

.5 Enclosure:

.1 CSA/NEMA 250, Type 4 except where indicated otherwise or where area classification requires higher rating such as Class I, Zone 1 or Zone 2.

.2 Entire unit enclosure shall be double O-ring sealed and watertight.

.6 Gearing:

.1 Actuator gearing shall be totally enclosed in grease-filled cast iron gear case.

.2 Provide single stage worm gearing designed to operate in any vertical or horizontal position, except inverted, and to allow gear disassembly without releasing valve stem thrust or taking valve out of service.

.7 Drive Unit:

.1 Motors and controls shall conform in all respects to applicable NEMA and CSA standards.

.2 Integral reversible motor.

.3 Size for 1.5 times required operating torque.

.4 Duty Cycle: 100%.

.5 Manual Override Handwheel: Include an automatic clutch to positively disengage handwheel any time drive motor control is energized.

.6 Complete with visual position indicator visible from normal walkway.

.7 Operation: Drive valve to fully OPEN or CLOSED position while OPEN or CLOSED external contact is made. Motor shall stop in mid travel when no input is received.

.8 Limit switches wired internally to stop motor at fully OPEN and fully CLOSED positions.

.9 Optional 120 VAC heater sized to prevent condensation and frost inside enclosure, where required.

.10 Motor thermal protection to sense motor temperature and de-energize motor in case of overheating.

.8 Actuators Without Integral LOCAL/REMOTE Selector Switch:

.1 Provide terminals for individual field adjustable 5 A, 120 VAC rated SPDT dry contact closed and open limit switch outputs for remote indication. Contacts shall maintain correct status while actuator is powered or not, without use of batteries.

.2 Provide terminals to accept remote OPEN (maintained) and CLOSE (maintained) 120 VAC control signals. Signal power shall be used to drive actuator motor.

.3 Acceptable Manufacturers:

.1 Unclassified Areas – Open-Close Service:

.1 Rotork; ROM Series.

.2 Limitorque; LY or L75 Series.

.3 Valvcon Corporation; V Series.

.2 Unclassified Areas – Modulating Service:

.1 Valvcon Corporation; V Series with 4-20 mA option card.

.2 Rotork CMA Series

.3 Class I, Zone 2 Hazardous Areas:

.1 Rotork; RCEL Series.

.2 Valvcon Corporation; V Series.

.9 Actuators With Integral LOCAL/REMOTE Selector Switch:

.1 Provide LOCAL/REMOTE and OPEN/CLOSE selector switches integral to actuator. Provide means to locally stop actuator in both local and remote modes.

.2 Provide terminals for individual field adjustable 5 A, 120 VAC rated SPDT dry contact closed and open limit switch outputs for remote indication. Contacts shall maintain correct status while actuator is powered or not, without use of batteries.

.3 Provide terminals to accept remote OPEN (maintained) and CLOSE (maintained) 24 VDC control signals when in REMOTE mode. Signal power source to be external to actuator.

.4 Provide terminals for 120 VAC external power source for actuator and all internal controls.

.5 Acceptable Manufacturers:

.1 Rotork; ROMpak Series.

.3 Electric Motor Actuators - Three Phase:

.1 General:

.1 Controls integral with the actuator and fully equipped as specified in AWWA 542.

.2 Stem protection for rising stem valves.

.3 Actuator ambient temperature range -40°C to 70°C and up to 100% relative humidity.

.4 Design that allows gear case to be opened for inspection or disassembly without releasing stem thrust or taking valve out of service.

.5 Equipped with side-mounted handwheel for manual operation. Include automatic clutch to positively disengage handwheel when drive motor control is energized.

.6 Design handwheel operator such that failure of motorized gearing will not prevent hand operation of valve.

.7 Circuitry which ensures motor turns in correct direction irrespective of supply polarity connected to power terminal; valve and operator to suffer no damage due to incorrect power connection.

.8 Instantaneous reversal protection whereby automatic time delay circuit limits current surges when actuator is signaled to instantaneously reverse direction.

.9 Anti-hammer protection whereby electronic torque limitation switches off actuator when preset load is reached due to obstruction or end of travel.

.10 Bi-metal thermostat embodied in motor control transformer windings to prevent overheating due to extensive use.

.11 Jammed valve motor protection whereby logic circuit protects motor from overheating by de-energizing motor if valve does not move after developing maximum torque.

.12 Opto-isolators incorporated to interface with remote control inputs to protect logic circuits from high voltage transients appearing at actuator terminals.

.13 Actuator shall include diagnostic module which will store and enable download of historical actuator data to permit analysis of changes in actuator or valve performance. Retrieval of this information must be demonstrated in the field.

.2 Actuator Operation:

.1 Suitable for full 90-degree rotation on quarter-turn valves or for use on multi-turn valves.

.2 Manual override handwheel.

.3 Valve position indication.

.4 Operate from fully CLOSED to fully OPEN positions or reverse in minimum of 60 seconds, unless indicated otherwise.

.5 Non-Intrusive Electronics: Local controls, diagnostics, and calibration, including limit and torque switch settings, shall be accomplished non-intrusively. Electronic valve position display with capability to show continuous torque output. If applicable, provide two hand-held configuration units for every 10 actuators provided, two minimum.

.3 Open-Close/Throttling Service:

.1 Capable of 60 starts per hour.

.2 Size with a minimum of 1.5 safety factor based on the maximum unseating and seating torque of the valve at its AWWA pressure classification. Safety factor shall be demonstrated and documented in Shop Drawings submittals and at time of commissioning under real service conditions using actuator software and torque display on actuator. Motor stall torque not to exceed capacity of valve.

.3 Actuator suitable for throttling operation of valve at intermediate positions.

.4 Controls and Indicators:

.1 PROFIBUS DP interface, unless otherwise noted.

.2 LOCAL-OFF-REMOTE selector switch, padlockable in each position.

.3 Integral OPEN-STOP-CLOSE momentary pushbuttons with seal-in circuits to control valve in LOCAL position.

.4 Remote OPEN-STOP-CLOSE momentary control dry contact inputs in REMOTE position. Integral seal-in circuits for remote OPEN and CLOSE commands; valve travel stops when remote STOP contact opens.

.5 Auxiliary contact that closes in REMOTE position.

.6 OPEN and CLOSED indicating lights.

.5 Integral reversing motor starter with built-in overload protection. Control transformer for 120-volt or 24-volt control voltage.

.6 Valve shall remain in last position on loss of operator power.

.4 Modulating Service:

.1 Size motors for continuous duty.

.2 Actuators to be sized with minimum 2.0 safety factor based on maximum unseating and seating torque of valve at its AWWA pressure classification. Safety factor shall be demonstrated and documented at time of commissioning under real service conditions using actuator software. Motor stall torque not to exceed torque capacity of valve.

.3 Feedback potentiometer and integral electronic positioner/comparator circuit to maintain valve position.

.4 Controls and Indicators:

.1 PROFIBUS DP interface, unless otherwise noted.

.2 LOCAL-OFF-REMOTE selector switch, padlockable in each position.

.3 Integral OPEN-STOP-CLOSE momentary pushbuttons with seal-in circuits to control valve in LOCAL position.

.4 Auxiliary contact that closes in REMOTE position.

.5 OPEN and CLOSED indicating lights.

.5 Valve shall close upon loss of signal unless indicated otherwise.

.6 Ac motor with solid state reversing starter or dc motor with solid state reversing controller, and built-in overload protection. Non-solid state compliant equipment will not be acceptable. Controller capable of 1200 starts per hour.

.7 Duty cycle limit timer and adjustable band width, to prevent actuator hunting.

.8 Valve position output converter controlled by a modulating analog signal with feedback signal in proportion to valve position, either through a PROFIBUS DP interface or 4-20 mA signals.

.5 Actuator Power Supply:

.1 600 VAC, three-phase, 60 Hz unless indicated otherwise.

.2 Control power transformer, 24-volt or 120-volt secondary.

.6 Enclosure:

.1 Unless indicated otherwise, provide enclosure as defined in NEMA 250, Type 6P.

.2 Contain 120-volt space heaters, or electrical compartment shall be non-breathing to prevent condensation.

.7 Fire Protection:

.1 Where indicated in Electric Motor Actuated Valve Schedule, provide actuator with intumescent coating system for fire protection.

.2 Coating shall provide minimum 30 minutes protection at 1093 degrees C and meet or exceed requirements of API 607 and UL 1709.

.3 Coating shall provide complete access to all actuator components and permit dismantling and re-assembly of actuator without disturbing coating.

.8 Limit Switches:

.1 Single-pole, double-throw (SPDT) type, field adjustable, with contacts rated for 5 amps at 120 volts ac.

.2 Each valve actuator to have minimum of two transfer contacts at end position, one for valve fully OPEN and one for valve fully CLOSED.

.3 Housed in actuator control enclosure.

.9 Product Standardization:

.1 This product was standardized by the City via RP 331-2014.

.2 No alternates or substitutes will be accepted.

.3 All requests for purchase or quotation shall reference RP 331-2014 to receive standardized pricing that the City has negotiated with the vendor.

.4 Manufacturer and Series:

.1 Rotork; IQ3.

2.3 Spare Parts

.1 Provide one (1) spare actuator for each type and size.

.2 Provide a list of all spare parts which would be expected to be required under normal conditions for a period of five (5) years. At the Contract Administrator's request, provide a price for these parts.

3. EXECUTION

3.1 Preparation

.1 Prior to installation of the valve and/or gate actuators, field measure and check all equipment locations, pipe alignments, and structural installations. Ensure that sufficient space and accessibility is available for electric actuators.

.2 Where conflicts are identified, initiate the necessary modifications.

3.2 Installation

.1 Install actuators, related panels, and wiring as recommended by the Manufacturer.

.2 Install control valves as described in other Divisions.

.3 Set limit switches to indicate valve positions or equipment status as required and indicated on Drawings.

.4 Provide stem-mounted stainless steel devices and hardware to actuate limit switches.

.5 Arrange limit switch contacts to close when valve is fully open, unless otherwise noted.

3.3 Field Testing and Commissioning

.1 Provide testing and commissioning in accordance with Division 1 and other requirements specified elsewhere.

.2 Factory test each actuator assembly prior to shipment.

.3 Automatic valves to be tested in conjunction with control system testing. Set all opening and closing speeds, limit switches, as required or recommended by the Contract Administrator.

.4 The Manufacturer's Representative will be required to commission the electric actuators to verify the installation and make final travel limits and torque adjustments.

3.4 City Training

.1 General:

.1 Provide an integrated training program for City's personnel.

.2 Perform training to meet specific needs of the City's personnel.

.3 Provide a detailed training manual covering all aspects of the training provided.

.4 Include training sessions, classroom and field, for maintenance personnel.

.5 The City reserves the right to make and reuse recordings of all training sessions.

.2 Training Requirements:

.1 Provide a minimum of 1 day of training at the site indicated by the City for personnel in the operation and maintenance of the 600 V, 3 phase valve actuators.

.2 Provide a minimum of 1 day of training at the site indicated by the City for personnel in the operation and maintenance of the 120 V, single phase valve actuators.

.3 Topics to include, but not be limited to:

.1 Operation and maintenance of the actuator.

.2 Setup and configuration of actuator.

.3 Troubleshooting.

3.5 Manufacturer's Services

.1 The valve type(s) as listed below require manufacturer's field services:

.1 All electric motor actuated valves.

.2 Manufacturer's Representative: Present at Site for minimum person-days listed below, travel time excluded:

.1 10 person-days for installation assistance and inspection.

.2 15 person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.

END OF SECTION

STAINLESS STEEL PIPE AND FITTINGS

1. GENERAL

1.1 Description

.1 Provide and test stainless steel pipe, fittings and appurtenances as indicated and specified.

1.2 References

.1 American Society of Mechanical Engineers (AMSE):

.1 B31.1: Power Piping.

.2 American Society for Testing and Materials (ASTM):

.1 A240: Specification for Heat Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.

.2 A380: Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment and Systems.

.3 A530: Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe.

.4 A774: Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.

.5 A778: Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.

.3 Fluid Sealing Association: Technical Handbook.

1.3 Submittals

.1 Submit the following in accordance with Section 01 33 00:

.1 Pipe manufacturer’s technical specification and product data.

.2 Certified shop and erection drawings. Construction Contractor shall submit electronic files of the piping layout including the following.

.1 Pipe layouts in full detail.

.2 Location of hangers and supports.

.3 Location and type of anchors.

.4 Location of couplings and expansion joints.

.5 Details of all wall penetrations and fabricated fittings or special fittings.

.6 Schedules of pipe, fittings, expansion joints and other appurtenances.

.3 Certificates: Sworn certificates in duplicate showing compliance with material used and shop tests performed with appropriate standard.

.4 Catalog cuts and technical data for expansion joints, couplings, gaskets, pipe supports and other accessories.

.5 Submit reports required for welding certifications per ASME B31.1 paragraph 127.6.

.6 Manufacturer's descriptive literature and technical data on insulation and proposed method of installation.

.2 Material Certification:

.1 Provide certification from the piping and fittings manufacturer that the materials of construction specified are recommended and designed for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and designed for the service conditions specified and indicated including an installation list of a minimum of five (5) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the City.

.2 Where materials are not specified, provide technical data and certification that the proposed materials are recommended and designed for the service conditions specified and indicated.

.3 A copy of the contract mechanical process, civil and structural drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with “No changes required” or provide a statement that no changes are required.

.1 Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

.2 A copy of this Specification Section with Addenda and all referenced Specification Sections with Addenda, with each paragraph check-marked to indicate Specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

.1 If deviations and clarifications from the Specifications are indicated, therefore requested by the Construction Contractor, provide a detailed written justification for each deviation and clarification.

.2 Failure to include a copy of the marked-up Specification Sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

1.4 Quality Assurance

.1 Provide Manufacturer's certification in writing, that materials meet or exceed minimum requirements as specified.

.2 Welder Qualifications:

.1 Quality and certify welding procedures, welders, and operators in accordance with ANSI B31.1, paragraph 127.5 for shop and project site welding of piping work.

.3 Job Conditions:

.1 Coordinate dimensions and drillings of flanges with flanges for valves, pumps and equipment to be installed in the piping systems.

1.5 Delivery, Storage and Handling

.1 During loading, transportation and unloading, prevent damage to pipes and fittings. Load and unload each pipe under control at all times. Under no circumstances will a dropped pipe be used unless inspected and accepted by the Contract Administrator. Place skids or blocks under each pipe in the shop and securely wedge pipe during transportation.

2. PRODUCTS

2.1 Stainless Steel Pipe

.1 Manufacturers:

.1 Douglas Brothers.

.2 Felker.

.3 Bristol Metals.

.4 Dixie Southern.

.5 Or Approved equal by the Contract Administrator.

.2 Materials:

.1 Type 316L sheet and plate per ASTM A240.

.2 Maximum carbon content of 316L material limited to 0.03%.

.3 Finish: 2D.

.4 Or Approved equals.

.3 Fabrication:

.1 Fabricate in accordance with ASTM A778 in NPS sizes shown with dimensional tolerances per ASTM A530.

.2 Perform welding by qualified welders conforming to standard procedures. Weld piping with wall thickness up to 11 gauge, 3 mm (0.125-inch) with the TIG (GTAW) process. Properly bevel heavier walls and use a root pass with the TIG (GTAW) process followed by subsequent passes with the TIG (GTAW), MIG (GMAW), or Metallic Arc (SMAW) process.

.3 Add filler wire of ELC grades to all welds to provide a cross section at the weld equal to or greater than the parent metal. Distribute smooth and evenly weld deposit and provide a crown of no more than 1.5 mm on the I.D. and 2.38 mm on the O.D. of the piping.

.4 Concavity, undercut, cracks or crevices are not acceptable.

.5 Butt Welds: Full penetration to the interior surface, with inert gas shielding provided to the interior and exterior of the joint.

.6 Remove excessive weld deposits, slag, spatter, and projections by grinding.

.7 Continuously weld angle face rings on both sides to the pipe or fitting.

.8 Grind all welds on gasket surfaces smooth.

.9 Contour pipe branches, taps and bosses to the radius of the main pipe run and bevel and weld with full penetration. No projections to the inside of the branch or main run are acceptable. Provide a smooth transition from ID of run to ID of branch.

.10 Wire-brush inside and outside weld areas with brushes of stainless steel that are specifically designed to be used only on stainless steel.

.11 After manufacture, passivate stainless steel pipe, fittings, and appurtenances by immersion in a pickling solution of 6% nitric acid and 3% hydrofluoric acid. Temperature and detention time to be sufficient for removal of oxidation and ferrous contamination without more than superficial etch of surface. Perform a complete neutralizing operation by immersion in a trisodium phosphate rinse followed by clean water wash. Perform in accordance with ASTM A380.

.12 After fabrication, either passivate by immersion (see above paragraph) or scrub interior and exterior of welds with same solution or pickling paste and stainless steel wire brushes to remove weld discoloration and then neutralize and wash clean. Perform in accordance with ASTM A380.

.13 Perform all welding in the shop. Field welding is not acceptable.

.1 If field welding is allowed for certain circumstances, the Construction Contractor shall submit the welders qualifications and an acceptable method of cleaning the pipe and fittings for review prior to start of any field welding.

.14 Fittings: Butt weld type manufactured in accordance with ASTM A774 of the same raw material and in the same thicknesses as the pipe. Socket weld fittings are not acceptable.

.1 Elbows up to 600 mm Diameter: Provide smooth flow-die formed, long radius; with centerline to end of elbow equal to 1.5 times the nominal pipe size.

.2 All short radius, special radius, and reducing elbows and long radius elbows greater than 600 mm diameter: Fabricate with pieces in accordance with the following table with dimensions in accordance with AWWA C208:

Bend, degrees	Number of Pieces
0 to 22.5	2
23 to 45	3
46 to 67.5	4
68 to 90	5

.15 Fabricate tees and branch connections true and square with wall thickness same as pipe.

.16 Reducers evenly tapered with tangent ends for butt weld connection.

.1 Reducers may be straight tapered cone construction.

.17 Secure flanges to pipe ends and plug openings prior to shipment.

.4 Design:

.1 Stainless steel pipe: Nominal pipe size diameter pipe fabricated of stainless steel sheets having the following Schedule, U.S.S. gauges and plate thickness:

Nominal Pipe Size (mm)	Actual O.D. (mm)	Schedule/Gauge/Plate
65	73	SCH 10
80	89	SCH 10
100	114	SCH 10
150	168	SCH 10
200	219	SCH 10
250	273	SCH 10
300	324	SCH 10
350	350	SCH 10
400	400	SCH 10
450	450	SCH 10
500	500	SCH 10
600	600	SCH 10
700	700	SCH 10
750	750	SCH 10
900	900	SCH 10
1000	1000	SCH 10

.2 For buried piping use a minimum SCH 10S or as indicated in the Process Piping Schedule.

.3 Joints: Flanged or, bolted split sleeve type couplings as indicated and specified. Split couplings requiring cut or roll grooving of the pipe not allowed unless specifically called for.

.4 Flanged Joints: Van Stone back-up flange type, ANSI 150 lb. (PN10).

.5 Provide stainless steel back-up flanges of the grade of pipe specified with the following thickness. Galvanized steel and ductile iron flanges are not acceptable.

Pipe Size, mm	Flange Thickness, mm
65, 80 and 100	10
150 and 200	13
250 to 450	19
500 and 600	19
700	22
750	22
900	25
1000	29

.6 Hardware: Type 316 stainless steel.

.7 Fabricate flanged joint face rings fabricated of rolled stainless steel angles.

.8 Use angle face rings with thickness equal to or greater than the wall of the pipe or fitting to which it is welded. Continuously weld on both sides to the pipe or fitting. Fabricate angle legs so as not to interfere with the flange bolt holes.

.9 Isolate stainless steel flanges from other ferrous metal connections at valves and equipment with flange insulating kit.

.1 Pipe flange insulating kit, double washer type:

.1 Flange gasket: Type E, 3 mm (1/8-inch) thick neoprene-faced phenolic.

.2 Insulating sleeves: 0.8 mm (1/32-inch) thick polyethylene, full length, one for each flange bolt.

.3 Insulating washers: 3 mm (1/8-inch) thick phenolic, two for each flange bolt.

.4 Mechanical washers: 3 mm (1/8-inch) thick type 316 stainless steel, two for each flange bolt.

2.2 Expansion Joints

.1 Provide in accordance with Section 40 05 30.

2.3 Pipe Supports

.1 Provide in accordance with Section 40 05 80.

3. EXECUTION

3.1 Installation

.1 Ensure pipelines parallel to building walls wherever possible. Install piping to accurate lines and grades. Where temporary supports are used, ensure rigidity to prevent shifting or distortion of pipe. Provide for expansion where necessary.

.2 Pitch piping toward low points. Provide for draining low points.

.3 Before assembly, remove dirt and chips from inside pipe and fittings.

.4 Make flanged joints with bolts; bolt studs with nut on each end; or studs with nuts where one flange is tapped.

.1 Except as otherwise specified, provide number and size of bolts conforming to same ANSI standards.

.2 Provide type 316 stainless steel hardware.

.3 Provide ring gaskets of materials designed for the service specified and indicated, 1.5 mm (1/16-inch) thick gaskets.

.4 Make up flanged joints tight with care being taken to prevent undue strain upon valves or other pieces of equipment.

3.2 Field Testing

.1 Clean of dirt, dust, oil, grease and other foreign material, before pressure and leakage tests.

.2 Pressure and Leakage Tests:

.1 Conduct combined pressure and leakage test in pipelines.

.2 Furnish and install temporary testing plugs or caps; pressure pumps, pipe connections, meters, gages, equipment, and labor.

.3 Test when desired and comply with Contract Administrator's orders and specifications.

.4 Fill section of pipe with water and expel air.

.5 Pressure and leakage test consists of first raising water pressure (based on elevation of lowest point of section under test and corrected to gage location) to pressure in psi (bar) numerically equal to test pressures indicated in the Process Pipe Schedule.

.6 No visible leakage in joints.

.7 If unable to achieve and maintain specified pressure for one (1) hour with no additional pumping, section failed to pass test.

.8 If section fails pressure and leakage test, locate, uncover, and repair or replace defective pipe, fitting, or joint, at no additional expense and without time extension. Conduct additional tests and repairs until section passes test.

.9 Immediately upon completion of testing, drain and dry piping to remove all traces of water and condensation.

.10 Modifications to test procedure only if permitted by Contract Administrator.

END OF SECTION

PROCESS PIPING AND EQUIPMENT INSULATION

1. GENERAL

1.1 Scope of Work

.1 The Scope of Work for this Section includes, but is not limited to, the following:

.1 Materials and procedures for the provision and installation of thermal insulation and heat tracing for process piping systems as indicated in the Drawings.

1.2 Quality Assurance

.1 Install insulation employing skilled workers regularly engaged in this type of Work.

.2 Materials shall meet or exceed fire and smoke hazard ratings as stated in this Section and defined in applicable building codes.

1.3 Submittals

.1 Submit Shop Drawings which indicate complete material data, "K" value temperature rating, density, finish, recovery jacket of materials proposed for this project and indicate thickness of material for individual services.

1.4 Shipment, Protection and Storage

.1 Deliver material to Site in original non-broken factory packaging, labeled with Manufacturer's density and thickness.

.2 Perform Work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Make good separation of joints or cracking of insulation due to thermal movement or poor workmanship.

2. PRODUCTS

2.1 General

.1 Insulation Materials, Recovery Jackets, Vapour Barrier Facings, Tapes and Adhesives.

.1 Composite fire and smoke hazard ratings shall not exceed 25 for flame spread and 50 for smoke developed rating when tested in accordance with CAN4-S102, NFPA 255 or ASTM E84.

.2 Provide insulating materials and accessories that withstand service temperatures without smouldering, glowing, smoking, or flaming when tested in accordance with ASTM C441.

.3 All insulation materials shall meet current Building Code Standards, and packages or containers of such materials shall be appropriately labeled.

.4 Insulate fittings and valve bodies with preformed removable insulated fittings.

2.2 Materials - Interior

.1 Cold piping interior: semi-rigid, pre-formed fibreglass or formed rigid mineral fibre pipe insulation, with factory applied paintable canvas vapour barrier jacket, factory moulded to conform with piping, "K" value: maximum 0.035 W/m°C at 24°C. Service temperature: minus 40°C to 150°C.

.2 Hot piping interior: semi-rigid, pre-formed fibreglass or rigid mineral fibre pipe insulation, with factory applied paintable canvas general purpose jacket, factory moulded to conform to piping, "K" value: maximum 0.035 W/m°C at 24°C. Service temperature: up to 200°C.

.3 Cold piping exterior: foamglass insulation with factory applied aluminum vapour barrier jacket, factory moulded to conform with piping. “K” value: maximum 0.035 W/m°C at 24°C. Service temperature: minus 40°C to 150°C.

.4 Hot piping exterior: foamglass insulation with factory applied aluminum vapour barrier jacket, factory moulded to conform with piping. “K” value: maximum 0.035 W/m°C at 24°C. Service temperature: minus 40°C to 150°C.

.5 Hot equipment flat surfaces: rigid mineral fibre insulation with factory applied paintable canvas general purpose jacket, factory moulded to conform to equipment. “K” value: maximum 0.035 W/m°C at 24°C. Service temperature: 20°C to 200°C.

.6 Hot equipment curved surfaces: mineral fibre blanket with factory applied paintable canvas general purpose jacket, factory moulded to conform to equipment. “K” value: maximum 0.035 W/m°C at 24°C. Service temperature: 20°C to 200°C.

.7 Recovery jackets: 0.9 mm smooth aluminum sheet or paintable canvas for all new insulated piping.

.8 Cold and hot water piping up to 115°C: as an alternate to formed fibreglass pipe insulation, rigid phenolic closed cell foam insulation equal to Kingspan Koolphen K CFC-free rigid phenolic insulation may be used. Product shall meet ASTM-E-84 and ASTM-C-585-90 and ULC burn and smoke spread rating for non-combustible installations (ULC-S102, S127).

2.3 Above-ground Piping

.1 Provide insulation for all pipe and equipment with an operating surface temperature in excess of 50°C. Use a minimum thickness of 25 mm. Use greater thicknesses as required to lower the outer skin temperature to below 40°C.

.2 Provide insulation for all piping where heat retention is required, at the locations indicated on the Drawings and for other piping systems where insulation is indicated on the Drawings.

.3 Provide insulation at pipe hangers and supports with factory applied vapour jacket and a self-sealing lap, manufactured specifically for use at support locations. It shall be a minimum of 200 mm long and of the same thickness as adjacent pipe insulation.

.4 Provide a suitable bonding agent to join the preformed sections.

.5 On exterior piping, provide aluminum jacketing with a minimum thickness of 0.9 mm, unless indicated otherwise.

.6 Provide aluminum banding, 12 mm wide by a minimum thickness of 0.5 mm with matching seals.

.7 Provide polypropylene jacketing at elbows, tees or other changes of direction and where indicated. Use the heat-shrink type jacketing, with a minimal thickness of 0.1 mm.

.8 On interior piping, provide paintable canvas jacketing, ULC listed, 0.27 kg/m^2 minimum.

3. EXECUTION

3.1 Preparation

.1 Do not install insulation and recovering before piping and equipment has been tested and approved.

.2 Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions.

3.2 Installation

.1 Ensure insulation is continuous through inside walls and floor penetrations. Pack around pipes with fireproof, self-supporting insulation material, properly sealed.

.2 Insulate piping and fittings as noted in the schedule below. Insulate valves unless otherwise noted. Do not insulate unions, flanges (except on flanged valves if valve must be insulated), Victaulic couplings, strainers, (except on chilled water lines), flexible connections and expansion joints. Terminate insulation neatly with plastic material trowelled on a bevel.

.3 Provide insulation on all process air pipes located in the building and tunnel areas. Use 50 mm thick fibreglass insulation over the entire length of the pipe run except over couplings, valves, and meters. Provide stainless steel bands over the insulation at a maximum of 300 mm centres.

.4 Unless indicated otherwise, do not insulate water body valves.

.5 Terminate insulation 100 mm on each side of all flanges and grooved joint couplings.

.6 Finish insulation neatly on hangers, supports, and other protrusions.

.7 Locate insulation or cover seams in least visible locations. Locate seams on piping in ceiling spaces on the underside of the pipe.

.8 Cover all insulated piping throughout with aluminum or paintable canvas recovery jacket secured with aluminum bands on 200 mm centres or screws on 150 mm centres, unless otherwise noted. Lap the joints a minimum of 75 mm. Align longitudinal seams in aluminum recovering to shed water. All bands and screws are to be accessible for service and removal.

.9 Cold piping: seal lap joints with 100% coverage of vapour barrier adhesive. Seal butt joints with 50 mm wide strips of vapour barrier sealed with vapour barrier adhesive. For fittings and valves, apply hydraulic insulating cement; or apply factory fabricated insulation half shells, seal all laps and joints.

.10 Flare out staples may be used to secure jacket laps on hot systems. Staples are to be applied on 100 mm centres.

.11 Hot piping: for fittings and valves, apply hydraulic insulating cement, or apply factory fabricated insulation half shells.

3.3 Process Pipe Insulation Installation Thickness Schedule

Piping or Equipment	Pipe Diameter	Insulation Thickness (fibreglass) mm	Insulation Thickness (closed cell phenolic) mm	Recovery Jacket
Insulated Process Piping, as shown on Drawings	15 to 50 Over 50	25 * 25 *	25 * 25 *	As noted in 2.2

* Unless stated otherwise elsewhere in the Specifications or on Drawings.

END OF SECTION

IO LISTS

1. GENERAL

1.1 Description

.1 The spreadsheets in Appendix E – IO List provide an itemized list of the new Programmable Logic Control (PLC) System inputs and outputs. This list shall be used in the design, selection of I/O cards, and sizing the associated PLC control panels, I/O racks, processors, power supplies, and associated appurtenances. It is also intended to serve as an aid for determining the cabling requirements for the Work specified in this Division.

.1 At the completion of testing, produce as-built IO lists for review. Update all columns of the IO list for the new installation. Update column reporting states, alarms, and scaling. Provide any notes for installations that are non-typical.

.1 As-built IO lists shall be inclusive of all hardwired and networked signals.

.2 As-built IO lists shall be based on the provided IO List templates in Appendix C and as described in the Automation Design Guide.

.3 As-built IO lists shall have all entries correctly filled out.

.2 Provide As-Built IO List in O&M Manuals.

2. PRODUCTS (NOT USED)

3. EXECUTION

3.1 Contract Closeout

.1 Provide in accordance with Section 01 78 00.

END OF SECTION

INSTRUMENT INDEX

1. GENERAL

1.1 Description

.1 Provide Instrumentation for Process Systems as specified in this section and in compliance with related detailed instrumentation specification sections and Contract Documents.

.2 The Work of this section includes the provision of instrument data sheets for all instruments supplied for this project. The contractor shall provide an as-constructed instrument data sheet for each instrument supplied for this project based on the ISA S20 standard for instrument specification forms.

1.2 Submittals

.1 Prepare and submit Instrument Data Sheets for each instrument supplied for this project in accordance with the ISA S20 standard. Clearly indicate all pertinent data for the respective instrument on the data sheets and clearly indicate any deviations from specified requirements. The completed Instrument Data Sheets shall be submitted together with and form an integral part of the instrumentation Shop Drawings specified in this Division.

2. PRODUCTS

2.1 Instrument Index

.1 The table provided in Appendix F – Instrumentation List is an itemized list of instrumentation to be supplied for this project. The instrumentation index provides detailed information for the tagged instrumentation devices shown on the P&ID diagrams and HVAC schematic diagrams.

3. EXECUTION

3.1 Instrument Data Sheets

.1 Contractor shall update the Instrument Data Sheets to reflect all changes in the work, and as required based on shop drawings that have been returned from the Contract Administrator with a “No Exceptions Taken” or “Make Corrections Noted” status.

.2 The as-constructed set of instrument data sheets shall be included in the O&M manual submittal.

3.2 Instrument Index

.1 Contractor shall update the Instrument Index to reflect all changes in the work, and as required based on shop drawings that have been returned from the Contract Administrator with a “No Exceptions Taken” or “Make Corrections Noted” status.

.2 The as-constructed Instrument Index shall be included in the O&M manual submittal.

3.3 Contract Closeout

.1 Provide in accordance with Section 01 78 00.

END OF SECTION

PROCESS TAPS AND PRIMARY ELEMENTS

1. GENERAL

1.1 References – General

.1 Section 40 90 00.

2. PRODUCTS

2.1 Process Taps

.1 Provide pressure gauge and thermowell taps. Coordinate requirements with other Divisions.

2.2 Primary Elements

.1 Provide primary elements and transmitters.

.2 Provide written assurance that the instrument manufacturer approves the selection of materials of primary elements, which are in contact with the specified process fluid and inert to the effects of the process fluid.

.3 Provide drip pots installed below sensing elements measuring gas. Provide seamless, stainless steel drip pots consisting of a 50 mm by 300 mm pipe with an isolating valve and a drain valve. Provide a separate drip pot for each sensing line. Locate the drain valve within 500 mm of the floor.

.4 Provide diaphragm seals on any fluid other than clean water or glycol.

.5 When diaphragm seals are specified with a pressure gauge or a pressure switch provide the assembly filled with ethylene glycol and calibrated by the manufacturer.

.6 When line-sized in-line pressure sensors are specified with a pressure gauge or a pressure switch (or combination of both), provide ethylene glycol filled assembly calibrated by the manufacturer.

3. EXECUTION (NOT USED)

END OF SECTION

1. GENERAL

1.1 Summary

.1 This Section gives general requirements for Instrumentation and Control related items. It is supplemental to the requirements defined in other specification sections.

.2 Comply with latest edition of all applicable codes and standards whether referenced in this Section or not.

.3 In the event any inconsistency is discovered between the Specifications, codes or standards, the most stringent shall apply.

1.2 General Requirements

.1 Refer to Division 1 for General Requirements related to the Contract Documents.

.2 Refer to all Sections of the Tender, Division 26, 40, Drawings, and Appendices.

.1 The intent of the Specifications and Drawings is to include all labour, products, and services necessary for complete Work, tested, commissioned and ready for operation.

.2 Symbols used to represent various electrical devices often occupy more space on the Drawing than the actual device does when installed. In such instances, do not scale locations of devices from electrical symbols. Install these devices with primary regard for usage of wall space, convenience of operation and grouping of devices. Refer to installation details where they exist.

.3 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 the present specifications.

1.3 References

.1 The following is a list of codes and standards are applicable as required:

.1 Institute of Electrical and Electronics Engineers (IEEE):

.1 C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

.2 IEEE 802.3u, 100BASE-TX, 100BASE-FX Ethernet at 100 Mbit/s.

.3 IEEE 802.3z, 1000BASE-X Gbit/s Ethernet over Fibre Optic.

.4 IEEE 802,3ab, 1000BASE-T Gbit/s Ethernet over twisted pair.

.5 IEEE 802,3x, Flow Control.

.2 The International Society of Automation (ISA):

.1 S5.1, Instrumentation Symbols and Identification.

.2 S50.1, Compatibility of Analog Signals for Electronic Industrial Process Instruments.

.3 62443, Security for Industrial Automation and Control Systems.

.3 Canadian Standards Association (CSA):

.1 C22.1 Canadian Electrical Code.

.2 C22.2, Electrical Safety Code.

.4 National Electrical Manufacturers Association (NEMA).

.5 National Fire Code, National Fire Protection Association (NFPA):

.1 NFPA 820, Fire Protection in Wastewater Treatment Plants.

.2 Comply with the following City of Winnipeg Standards documents:

.1 Automation Design Guide.

.2 Electrical Design Guide.

.3 HMI Layout and Animation Plan.

.4 Identification Standard.

.5 Tag Naming Standard.

.6 Winnipeg Electrical By-Law.

.7 Information Bulletins.

.3 Manitoba Hydro:

.1 Manitoba Electrical Code, most current adopted revision.

.2 Manitoba Hydro Inspection Notices.

1.4 Acronyms and Abbreviations

.1 CP: Control Panel.

.2 DCS: Distributed Control System.

.3 FAT: Factory Acceptance Test.

.4 FOCS: Fibre Optic Communication Subsystem.

.5 HVAC: Heating, Ventilating, and Air Conditioning.

.6 I&C: Instrumentation and Control.

.7 I/O or IO: Input and Output.

.8 HMI: Human-Machine Interface, alias for Operator Interface.

.9 LCP: Local Control Panel.

.10 MCC: Motor Control Center.

.11 O&M: Operation and Maintenance.

.12 OWS Operator Work Station.

.13 PC: Personal Computer.

.14 PCS: Process Control System comprising PLC's, and HMIs, communications systems and related hardware and software.

.15 PCU: Process Control Unit, a DCS subsystem.

.16 PCS: Process Instrumentation and Control System.

.17 P&ID: Process and Instrument Diagram.

.18 PLC: Programmable Logic Controller.

.19 SAT: Site Acceptance Test.

.20 SIT: Site Integration Test.

.21 SIFT: System Integration Functional Test.

.22 UPS: Uninterruptible Power Supply.

.23 VFD: Variable Frequency Drive.

.24 See the Identification Standard for further Abbreviations.

1.5 Supplemental Documents

.1 Documents related to the Automation Work:

.1 Process Control Narratives.

.2 Instrument Lists:

.1 Instrument lists are provided to aid the Contractor's work. If there are any discrepancies between these documents and the Drawings and Specifications, the Drawings and Specifications shall take precedence.

.3 IO Lists:

.1 IO lists are provided to aid the Contractor's work. If there are any discrepancies between these documents and the Drawings and Specifications, the Drawings and Specifications shall take precedence.

.4 Instrument Datasheets:

.1 See 40 91 01 Instrumentation and Control Components for details on datasheets.

.5 Manual Control Details.

.6 Cable Lists.

.7 Automation Equipment List.

1.6 Submittals

.1 General:

.1 Submit proposed Submittal breakdown list consisting of all PCS component submittals. Sequencing and packaging of information to be in accordance with Progress Schedule.

.2 Partial Submittals not in accordance with Progress Schedule will not be accepted.

.3 Obtain Contract Administrator's approval if Submittals for a PCS subsystem are to be made in multiple packages.

.4 Provide submittals sufficiently in advance of requirements to allow ample time for review.

.5 Mark shop drawings and data submitted showing only items applicable to specific contract. Complete catalogues that have not been curated to the specific products submitted will be rejected.

.2 Shop Drawings and Product Data:

.1 Prior to delivery of any Products to job site, submit Shop Drawings and Product Data as specified in Section 01 33 00, Submittal Procedures for all equipment as required in the Specifications.

.2 Prior to submitting the Shop Drawings to the Contract Administrator, the Contractor shall review the Shop Drawings to determine that the equipment complies with the requirements of the Specifications and Drawings.

.3 The term "Shop Drawing" means drawings, diagrams, illustrations, schedules, performance characteristics, brochures and other data, which are to be provided by the Contractor to illustrate details of a portion of the Work. Indicate materials, methods of construction and attachment of support wiring, diagrams, connections, recommended installation details, explanatory notes and other information necessary for completion of Work. Where equipment is connected to other equipment, indicate that such items have been coordinated, regardless of the section under which the adjacent items will be supplied and installed. Indicate cross-references to design drawings and specifications. Adjustments made on Shop Drawings by the Contract Administrator are not intended to

change the Contract price. If adjustments affect the value of the Work, state such in writing to the Contract Administrator prior to proceeding with the Work.

.4 Equipment identifiers shall be included on all Shop Drawings and product data submittals to clearly identify the equipment they apply to.

.5 Provide CSA or cUL certified equipment and material.

.6 Manufacture of Products shall conform to revised Shop Drawings.

.3 Informational Submittals:

.1 Provide informational submittals in accordance with other Specification Sections including but not limited to the following:

.1 Training Plan: In accordance with other Specification Sections.

.2 Testing and Commissioning Forms: In accordance with other Specification Sections.

.3 Operation and Maintenance Data: In accordance with Section 01 91 31, Commissioning Plan and in addition to the following:

.1 Outline of O&M data.

.2 Sufficient detail to allow operation, removal, installation, adjustment, calibration, maintenance and purchasing replacements for each PCS component.

.4 As-Built Drawings: In accordance with Section 01 78 00, Closeout Procedures.

.2 Extra Materials:

.1 List of proposed spares, expendables, and test equipment. Separate Submittals for each PCS subsystem.

.2 Recommended Spare Parts: List of, and descriptive literature for, additional spares, expendables, and test equipment recommended by PCS Integrator. Include quantities, unit prices, and total costs.

1.7 Drawings and Specifications

.1 The intent of the Drawings and Specifications is to indicate labor, products, and services necessary for a complete, installed, tested, commissioned and functional installation.

.2 PCS drawings may indicate approximate route to be followed by conduits and cables and general location of electrical equipment. They do not show all structural, architectural, and mechanical details. The details on exact cable or conduit routing, and exact equipment installation location is to be determined on site and coordinated with all other trades.

.3 To provide sufficient detail and maximum degree of clarity on the drawings, symbols used for various electrical devices, particularly wall mounted devices, take up more space on the

drawings than devices physically do. Locate devices with primary regard for convenience of operation, accessibility and space utilization, rather than locating devices to comply with the exact scaled locations of the electrical symbols.

.4 The PCS specifications and drawings and the specifications of all other divisions shall be considered as an integral part of the work. Any item or subject omitted from either the specifications or the drawings but which is mentioned or reasonably specified by the drawings or specifications of other divisions, shall be considered as properly and sufficiently specified and shall be provided.

.5 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 a bid.

.6 Provide all minor items and work not shown or specified but which are reasonably necessary to complete the work.

.7 Various package unit types of equipment are included in the work. It is the responsibility of the Contractor to familiarize himself with the requirements of the equipment vendor, and to include all materials and labor for a complete and working installation. In some cases this means that control panels, instruments, actuators, etc. need to be wired and connected in the field. The Contractor shall include all costs to perform such services as part of his tender submittal. Coordination between the equipment vendor and the contractor shall be performed prior to tender bid closing date, and all costs shall be included in the tender. Request for extras due to lack of coordination between the Contractor and the equipment vendors will not be accepted.

.8 Cables schedules / lists where shown do not include all cables required to perform the complete facility installation. They shall be used as a general guide. Accurate cable lists, quantities, take-offs remain the responsibility of the Contractor.

1.8 Care, Operation, and Start-up

.1 Instruct City maintenance and operating personnel in the operation, care and maintenance of systems, system equipment and components.

.2 Where services of a manufacturer’s factory service engineer is required, arrange and pay for services to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation and ensure that operating personnel are conversant with all aspects of its care and operation.

1.9 Permits, Fees and Inspection

.1 The Contract Administrator will submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of Work.

.2 The Contractor shall pay associated fees as required by the Electrical Inspections and Permitting department.

.3 Notify the Contract Administrator of changes required by Electrical Inspection Department prior to making changes.

.4 Furnish a Certificate of Final Inspection and approvals from inspection authority to the Contract Administrator.

1.10 Materials and Equipment

.1 Provide materials and equipment in accordance with Section 01 61 00, Common Product Requirements.

.2 Equipment and material to be CSA or cUL certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Inspection Department.

.3 Minimum enclosure type to be used is NEMA 12 unless otherwise specified.

.4 Junction Boxes:

.1 All field wiring connections to be located in junction boxes with terminals. The design documents show the expected junction boxes to be required. However, the Contractor must provide all junction boxes required, whether or not the junction boxes are shown in the design documents.

1.11 PCS Coordination

.1 Coordinate work with all other trades to ensure that conflicts do not occur.

.2 Coordinate requirement of mechanical equipment requiring electrical connection with the mechanical contractor.

.3 Coordinate work with City plant operation and maintenance.

.4 Coordinate work with other projects on site.

1.12 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 enclosures light grey to ANSI 61 grey enamel, unless otherwise specified.

.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 Refer to Section 09 91 00, Painting and Coating for additional information.

1.13 Equipment Identification

.1 Identify PCS equipment with nameplates.

.2 All identifiers shall be consistent with the most recent version of the City of Winnipeg Water and Waste Department Identification Standard 510276-0000-40ER-0002 and as shown on drawings.

.3 Nameplates:

.1 Lamacoid, 3 mm thick plastic nameplates, mechanically attached with self tapping stainless steel screws, white face with black lettering. Note: “Sheet Metal Screws” or other sharp pointed screws are NOT acceptable.

.2 Sizes as follows:

Table 1.1: Nameplate Sizes

Size	Dimension	Lines of Text	Text Height
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	40 x 90 mm	2 lines	8 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	5 mm high letters
Size 8	35 x 100 mm	3 lines	5 mm high letters
Size 9	45 x 100 mm	4 lines	5 mm high letters
Size 10	75 x 160 mm	3 or 4 lines	8 mm high letters
Size 11	150 x 250 mm	3 or 4 lines	10 mm high letters

.3 Wording on nameplates to be approved by Contract Administrator prior to manufacture.

.4 Allow for average of fifty (50) letters per nameplate.

.5 Identification to be in English.

.4 Provide nameplates for the following, sizes as shown:

.1 Cabinets – Size 8.

.2 Small Junction Boxes (150 mm x 150 mm or smaller) – Size 1.

.3 Large Junction Boxes – Size 2.

.4 Control panels – Size 8.

.5 Field Devices (Instruments, Actuators, etc.) – Size 4.

1.14 Wiring Identification

.1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Wire tags to be heat shrink type with mechanically printed black letters on white background.

1.15 Conduit and Cable Identification

.1 Colour code conduits, boxes and cables.

.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 5 m intervals.

.3 Colours: 38 mm wide prime colour and 19 mm wide auxiliary colours.

Table 1.2: Conduit and Cable Colour Code

System	Prime Band	Aux. Band
Medium Voltage (>750 V)	Orange	
347/600 V	Yellow	
120/208/240 V Power	Black	
UPS 120/208/240 V Power	Black	Green
Control Wiring (120 V)	Black	Orange
Fire Alarm	Red	
Low Voltage Communication/General	Blue	
Low Voltage Control Wiring (<50 V)	Blue	Orange
Intrinsically Safe	Blue	White
Ground	Green	
Fibre Optic	Purple	

.4 Cable Identification: Supply and install lamacoid type cable identification tags for all cables. Install identification tag at both ends.

1.16 As-Built Drawings and Documents

.1 Refer to Section 01 78 00 – Closeout Submittals for additional requirements for As-Built Drawings and documents.

.2 The Contractor shall keep one (1) complete set of white prints at the Site during the work, including all addenda, change orders, Site Instructions, clarifications, and revisions for the purpose of As-Built Drawings. As the Work on-site proceeds, the Contractor shall clearly record in Red Pencil all as-built conditions, which deviate from the original Contract Documents.

.3 The Contractor shall keep one (1) completed set of automation documents at the Site during the work, including all addenda, change orders, Site Instructions, clarifications, and revisions for the purpose of As-Built documents. This includes, but is not limited to the following:

.1 IO Lists.

.2 Instrument Lists.

.3 IP Address Lists.

.4 Automation Equipment List.

.4 On completion of the work, minimum of four (4) weeks prior to final inspection, submit As-Built Drawings and documents to Contract Administrator for review. The Contractor shall certify, in writing signed and dated, that the As-Built Drawings are complete and that they accurately indicate all electrical services, including exposed as well as concealed items.

.5 Comply with all other City of Winnipeg standards and requirements.

1.17 Operation and Maintenance (O&M) Manuals

.1 Provide operation and maintenance manuals as specified herein and in accordance with the general conditions. Refer to Section 01 91 31 - Commissioning Plan.

.2 Include in the operations and maintenance manuals a minimum of:

.1 Cover page including project name, year, name of owner and electrical consultant. Cover page shall be enclosed in a clear plastic cover.

.2 Index.

.3 List of manufacturers and supplier for all items.

.4 Names, address and phone number of all local suppliers for items included in maintenance manual.

.5 Stamped and signed Shop Drawings.

.6 Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of portions or features of the installation.

.7 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items and parts lists. Advertising or sales literature not acceptable.

.8 All test results performed. This includes, but is not limited to fibre optic tests; Control System network tests; Profibus Network Tests; FAT, SIFT, SIT and SAT tests.

.9 PLC and HMI Programs on USB memory stick.

.10 As-Built drawings.

.11 Signed and dated warranty certificate.

.12 Signed and dated approval by the local Electrical Inspections Department.

.13 All other requirements outlined in the specifications.

.3 Submit draft document prior to the start of commissioning.

1.18 Environmental Conditions

.1 Equipment and systems are to be rated to correctly operate in the environment in which they are to be installed.

.2 Exterior devices shall be rated to operate in an exterior environment with temperature range of -40°C to +40°C.

1.19 Quality Assurance

.1 Qualifications:

.1 For work involving specialties, including, but not limited to, the installation of sound and intercommunication systems, fire alarm systems, lightning protection systems, grounding systems, instrumentation, controls, electronic access, security systems, fibre optics systems, etc. employ only workers fully trained, qualified and experienced in the aspects of such work.

2. PRODUCTS

2.1 General

.1 The design is based upon the manufacturers and model numbers shown on the drawings and in the specifications. If a manufacturer chosen after project award is different from that on which the design is based, the design must be modified by the Contractor based on the chosen manufacturer. If additional engineering work is required, the Contractor must provide an Engineer's seal for the change to the design.

.2 The City has standardized on a specific vendor for the supply and delivery of control system and motor control equipment. The Standardization Vendor was selected via RFP 756-2013 and was awarded to Schneider Electric Canada Inc. (Schneider). Refer to City standardized goods agreement for details.

.3 The City has standardized on a specific vendor for the supply and delivery of specific instrumentation. The Standardization Vendor was selected via RFP 449-2014 and was awarded to Trans-West Supply Company Inc. (Trans-West). Refer to City standardized goods agreement for details.

.4 Substitutes:

.1 Provide all additional and modified wiring, raceway, enclosures, intrinsically safe barriers, and accessories at no additional cost associated with approved substitutes.

.5 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.

.2 Implement all same or similar functions in same or similar manner. For example, control logic, sequence controls, and display layouts.

3. EXECUTION

3.1 Preparation and Protection

.1 Schedule expediting of materials and execution of work in conjunction with associated work of other trades in order to meet the required work schedule.

.2 Post engraved warning signs to meet requirements of local bylaws, Inspection Authority and Contract Administrator.

.3 Protect those working on or in vicinity of exposed electrically energized equipment from physical danger. Shield and mark live parts in accordance with local regulations. Indicate the appropriate voltage.

.4 Arrange for installation of temporary doors, barriers and similar items for access to rooms and areas containing electrical equipment. Keep these doors locked at all times, except when under direct supervision.

.5 Permanently identify with lamacoid nameplate, equipment energized from multiple power sources, noting voltages, power source locations, supply disconnect designations and grounding electrode location.

3.2 Warning Signs

.1 As specified and to meet the requirements of Electrical Inspection Department and the Contract Administrator.

.2 Lamacoid 3 mm thick plastic engraving sheet, red face, white core, mechanically attached with self tapping screws, 20 mm text.

3.3 Mounting Heights

.1 Unless otherwise noted, or in contravention of codes and standards, mount equipment replacing existing equipment at the same height.

.2 Mounting height of equipment is from finished floor to centerline of equipment unless specified or indicated otherwise.

.3 Typical mounting heights are as follows:

.1 Wall mounted instruments: 1.5 m Above Finished Floor (AFF).

.2 Wall mounted junction boxes: 1.5 m AFF.

.3 Wall mounted small panels: 1.5 m AFF.

.4 Wall mounted large panels: Top of cabinet at 2.0 m AFF.

.5 Gas detection horns and strobes: 2.0 m to 4.0 m AFF.

.6 Motor control hand switches: 1.5 m AFF.

.7 Valve actuator control stations: 1.5 m AFF.

.4 If mounting height of equipment is not indicated, verify with the Contract Administrator prior to proceeding with the installation.

3.4 Modifications to Existing Cabinets

.1 Where significant modifications are made to existing cabinets, the cabinet shall be inspected by the Authority Having Jurisdiction.

3.5 IP Addresses

.1 IP Addresses will be provided to the Contractor for all network devices after project award. The Contractor will be required to sign a Non-disclosure Agreement and confidentiality agreement in relation to the IP Addresses.

3.6 Devices with Integral Leads

.1 For devices with integral leads, if the location of the device does not allow the leads to reach the junction box as shown on the drawings, provide additional wiring, conduit and boxes as required to extend the leads to the associated junction box.

3.7 Location of Devices

.1 Allow for change of location of devices at no extra cost or credit, provided that the distance does not exceed 3000 mm (10') from that shown on the drawings, when the requirement is made known prior to installation.

3.8 Conduit and Cable Installation

.1 Sleeves through concrete: schedule 40 galvanized steel pipe, sized for free passage of conduit.

.2 For wall, partitions, and ceilings the sleeve ends shall be flush with the finish on both sides but for floors they shall extend 25 mm (1") above finished floor level.

.3 Fire stop opening with ULC approved assembly for the installation conditions.

.4 Provide a detailed proposed conduit routing plan to the Contract Administrator prior to proceeding with the installation of conduit.

.5 If possible, avoid routing conduits through hazardous area.

.6 Separate cables of different voltage levels when cables are installed parallel to each other.

3.9 Cutting, Patching, and Drilling

.1 Provide all cutting and patching as required.

.2 Return exposed surfaces to an as-found condition.

.3 Exercise care where cutting/drilling holes in existing concrete elements so as not to damage existing reinforcing, or any other systems run in the concrete.

.1 Locate reinforcing and other existing systems using ground penetrating radar, X-Ray or other suitable means. Mark out on the surface of the concrete the locations of rebar and all other systems.

.2 For all holes larger than 50 mm passing through reinforced concrete, mark the location of the desired hole and all embedded systems. Obtain approval from the Contract Administrator prior to cutting.

.4 Firestop and seal all penetrations.

.5 Ensure that water ingress will not occur.

.6 Provide expansion joints for penetrations where shifting can occur.

3.10 Anchor Installation

.1 The Contractor shall exercise care where installing anchors into existing concrete elements so as not to damage existing reinforcing. All anchors shall be installed utilizing carbide tip drill bits. The existing reinforcing shall be located utilizing a reinforcing bar locator and marked out on the surface of the concrete. The drill holes shall be advanced to the required depth for installation of the anchors. Should reinforcement be encountered while drilling, the hole shall be terminated and repositioned to clear the reinforcement. Do not use core bits that can easily intercept and damage/cut the reinforcing during drilling.

3.11 Field Quality Control

.1 All electrical work to be carried out by qualified, licensed electricians or apprentices as per the conditions of the Provincial Act respecting manpower vocational training and qualification. Employees registered in a provincial apprentices program shall be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks - the activities permitted shall be determined based on the level of training attained and the demonstration of ability to perform specific duties. A maximum of one apprentice is permitted per qualified electrician.

.2 The Work of this Division to be carried out by a contractor who holds a valid Master Electrical contractor license as issued by the Province of Manitoba.

3.12 Touch-Up Painting

.1 Clean and touch up surfaces of shop painted equipment scratched or marred during shipment or installation, to match original paint.

.2 Obtain necessary touch-up paint of original type and quality from equipment manufacturer.

.3 Clean surfaces to be painted. Feather out edges of scratch marks. Make patch inconspicuous.

.4 Apply one or more coats until damaged surface has been restored to original finish condition.

.5 Clean and prime exposed non galvanized hangers, racks and fastenings to prevent rusting.

.6 Do not paint nameplates, tags, CSA labels, warning plates and operating instructions. Observe field painting of electrical equipment or raceways. Labels shall be visible and legible after the equipment is installed.

3.13 Cleaning

.1 Clean construction debris and materials from enclosures, before final electrical tests. Vacuum the interior and exterior of enclosures to ensure all equipment is free from debris. No loose items shall be in the bottom of cabinet before the final electrical tests. Any spare parts, drawings, documentation, etc. should be stored in the appropriate area in the cabinet.

3.14 Provision for Future Expansion

.1 In each location where space for future equipment is indicated, leave such space clean. Install conduit, wiring and other work in such a manner that necessary connections can be made in future without dismantling existing equipment, raceways or wiring. Consult with Contract Administrator whenever necessary.

END OF SECTION

FIELD SERVICES

1. GENERAL

1.1 Scope of Work

.1 This Section describes the requirement for field services required to place, install, wire, connect, test, verify and document the installation of all components and related training.

.2 Provide all labour, equipment and materials required for the installation, testing and commissioning, and start-up of the PCS.

.3 Cooperate and coordinate with the City, the PCS system integrator, and other contractors to fully test and commission all components of the PCS system.

.4 Provide network connections and power supply connections, from the electrical distribution panels for all equipment requiring power.

.5 Coordinate the installation of equipment with Division 26.

.6 Coordinate the field instrumentation requirements with other Divisions.

1.2 Submittals

.1 Submit the proposed forms for documenting the checkout and verification phases of all of the work.

1.3 Qualifications

.1 Provide a qualified, factory authorized field-service representative for the installation and set-up of new equipment.

.2 Provide the services of qualified installers for any equipment and communications cable required to and from the patch panels, to the PLCs and PCS. For fibre optic media systems use personnel expressly trained at splicing, terminating, and testing of fibre optic cabling.

.3 For installation of field raceways and wiring use qualified trades people.

2. PRODUCTS

2.1 Equipment and Materials

.1 Provide all equipment and materials necessary for the un-loading, handling, placement, installation and testing of all control system equipment.

3. EXECUTION

3.1 Installation

.1 Provide for the off-loading and placement of all equipment in the field.

.2 Inspect equipment for mechanical and electrical damage prior to shipping, arrival at Site, during unpacking and after final placement of equipment. Replace or repair any damaged equipment to the satisfaction of the Contract Administrator.

.3 Prepare damage reports and make all claims against the carrier.

.4 Provide adequate protection for the equipment after installation. Do not install equipment in locations that are not sufficiently complete to maintain the proper environmental conditions for the equipment.

.5 Certify in writing that equipment has been installed as per Drawings and recommended installation procedures. Report any discrepancies to the Contract Administrator.

.6 Provide and install the AC power supply from the distribution panels and connect to systems ground for the equipment. Certify in writing that equipment power and grounding requirements have been satisfied. Report any discrepancies.

.7 Certify in writing that field wiring is properly installed and correctly identified. Report any discrepancies to the Contract Administrator.

.8 Make adjustments necessary to place equipment in trouble-free operation. Submit any amendments to calibration certificates to the Contract Administrator.

.9 Certify that the system is ready for field testing.

.10 Update and submit to the Contract Administrator or the As-Built Drawings and CAD files for the installed systems.

END OF SECTION

1. GENERAL

1.1 References

.1 Comply with latest edition of the codes and standards applicable and/or referenced in Section 40 90 00, Instrumentation and Control for Process Systems 1.3 and this Section.

.2 The following is a list of standards which may be applicable in this Section:

.1 Canadian Standards Association (CSA):

.1 CSA C22.1, Canadian Electrical Code, Part I - Safety Standard for Electrical Installations.

.2 CSA C22.2 No .0.3, Test Methods for Electrical Wires and Cables.

.3 CAN/CSA-C22.2 No. 38, Thermoset-Insulated Wires and Cables.

.4 CAN/CSA-C22.2 No. 131, Type TECK 90 Cable.

.5 CAN/CSA-C22.2 No. 174, Cables and Cable Glands for use in Hazardous locations.

.6 CAN/CSA-C22.2 No. 239, Control and Instrumentation Cables.

.7 CAN/CSA-C22.2 No. 214, Communications Cables.

1.2 Submittals

.1 Submit product data in accordance with Section 01 33 00, Submittal Procedures.

2. PRODUCTS

2.1 Conduits

.1 See Electrical Specification 26 05 34, Conduit, Conduit Fasteners, and Conduit Fittings – Electrical for general conduit requirements.

2.2 Wires in Conduit

.1 Wire : to CAN/CSA-C22.2 No. 38.

.2 Conductors:

.1 Size as indicated.

.2 Copper conductors.

.3 Insulation: chemically cross-linked thermosetting polyethylene rated type RW90.

.1 Insulation Voltage Rating:

.1 Circuits 120 V and less: 600 V.

.4 Wire Colour Coding:

.1 Utilize the following wire colours for the types of voltage/signals indicated:

.1 120 VAC Line: Black.

.2 120 VAC Control: Red.

.3 120 VAC Neutral: White.

.4 24 VDC Supply: Blue.

.5 24 VDC Control: Blue.

.6 24 VDC Common: Brown.

.7 4-20 mA Signal: White (+), Black (-).

.8 Protective Earth: Green.

.9 Signal Ground: Green/Yellow.

.10 Profibus: Red/Green.

2.3 TECK90 Multi-Conductor Cable

.1 Cable: to CAN/CSA-C22.2 No. 131.

.2 Conductors:

.1 Grounding conductor: copper.

.2 Circuit conductors: copper, size as indicated.

.3 Insulation: chemically cross-linked thermosetting polyethylene (XLPE), rated type RW90.

.1 Insulation Voltage Rating: 600 V.

.4 Inner jacket: polyvinyl chloride material.

.5 Armour: interlocking aluminum.

.6 Overall covering: polyvinyl chloride material.

.7 Fastenings:

.1 One-hole aluminum straps to secure surface cables 50 mm and smaller. Two-hole aluminum straps for cables larger than 50 mm.

.2 Channel type or cable tray supports for two (2) or more cables.

.8 Cable Connectors / Fittings:

.1 Minimum requirements: Watertight, approved for TECK cable.

.2 Hazardous Locations:

.1 CSA approved.

.2 Watertight type with:

.1 An elastomeric bevelled bushing.

.2 A funnel entry, splined gland nut.

.3 A non-magnetic, stainless steel grounding device with dual grounding action.

.4 A taper threaded hub.

.5 A hexagonal body and gland nut.

.3 Integral seal type with metal-to-metal contact construction.

.4 Sealing of multi-conductor cable shall be accomplished with a liquid-type polyurethane compound.

.5 The fitting must:

.1 Provide an environmental seal around the outer jacket of the cable and electrically bond the fitting to the cable armour prior to potting the explosion-proof seal.

.2 Allow the possibility of disconnection without disturbing the environmental seal, the electrical bonding, or the explosion proof seal.

.6 All metal-clad cable fittings, for jacketed and non-jacketed interlocked armour cable, shall incorporate an easily removable armour stop (not requiring fitting disassembly) ensuring proper positioning of the cable armour during cable termination.

.3 Approved products: Thomas & Betts Star® Teck XP series or approved equal.

2.4 ACIC/CIC Control Cable

.1 Cable: to CAN/CSA-C22.2 No. 239, Control and Instrumentation Cables.

.2 Conductors: copper, stranded, size as indicated.

.3 Insulation: chemically cross-linked thermosetting polyethylene(XLPE) rated type RW90.

.1 Voltage: As noted.

.4 Shielding as indicated on the drawings:

.1 ISOS – Individually shielded pairs with overall shield.

.2 OS – Overall shield.

.5 Armour Type: Aluminum Interlocked.

.6 RoHS compliant.

.7 Fastenings:

.1 One-hole aluminum straps to secure surface cables 50 mm and smaller. Two-hole aluminum straps for cables larger than 50 mm.

.2 Channel type supports for two (2) or more cables at 1000 mm centres.

.3 Threaded rods: 6 mm dia. To support suspended channels.

.8 Cable Fittings:

.1 Minimum requirements: Watertight, approved for TECK cable.

.2 Hazardous Locations:

.1 CSA approved.

.2 Watertight type with:

.1 An elastomeric bevelled bushing.

.2 A funnel entry, splined gland nut.

.3 A non-magnetic, stainless steel grounding device with dual grounding action.

.4 A taper threaded hub.

.5 A hexagonal body and gland nut.

.3 Integral seal type with metal-to-metal contact construction.

.4 Sealing of multi-conductor cable shall be accomplished with a liquid-type polyurethane compound.

.5 The fitting must:

.1 Provide an environmental seal around the outer jacket of the cable and electrically bond the fitting to the cable armour prior to potting the explosion-proof seal.

.2 Allow the possibility of disconnection without disturbing the environmental seal, the electrical bonding, or the explosion proof seal.

.6 All metal-clad cable fittings, for jacketed and non-jacketed interlocked armour cable, shall incorporate an easily removable armour stop (not requiring fitting disassembly) ensuring proper positioning of the cable armour during cable termination.

.3 Approved products: Thomas & Betts Star® Teck XP series or approved equal.

2.5 Ethernet Cable – Shielded, 300V Non-Armoured, Low-Bend Radius for Use Only in Automation Panels Patch Cords and Between Ganged Automation Panels

.1 Requirements:

.1 Cable: Industrial Grade Cat 6, 300V, Shielded, Ethernet cable.

.2 Shield Design: Overlapped aluminum-clad foil, sheathed in a braided screen of tin-plated copper wires.

.3 Conductors: 4 pair, 24 AWG, copper, solid.

.4 Insulation: Polypropylene.

.5 Operating temperature: 40°C to 85°C.

.6 Installation temperature: -40°C to 85°C.

.7 c(UL)us, CMG, RoHS compliant.

.8 Traction stress maximum: 100 N.

.9 Minimum bending radius: 24 mm single bend/40 mm multiple bends.

.10 Manufacturer: Siemens 6XV1878-2A or approved equal.

2.6 Ethernet Cable – Shielded, 600 V, Non-Armoured

.1 Requirements:

.1 Cable: Industrial Grade Cat 6, 600 V, Shielded.

.2 Shield Design: 100% coverage Foil Shielded

.3 Conductors: four (4) pair, Bonded pair, 23 AWG, copper, solid.

.4 Insulation: Polypropylene.

.5 Operating temperature: -40°C to 75°C.

.6 Installation temperature: -25°C to 75°C.

.7 Flame test: CSA FT4.

.8 cUL, CMR, RoHS compliant.

.9 Traction stress maximum: 177.928 N.

.10 Minimum bending radius: 101.600 mm.

.11 Manufacturer: Belden 7953A or approved equal.

2.7 Ethernet Cable – Unshielded, 300 V, Armoured

.1 Requirements:

.1 Cable: Industrial Grade, Enhanced Cat 6 Cable, 300V, Solid, Unshielded, Aluminum Interlocked Armor.

.2 Conductors: 4 Pair, Bonded pair, 23 AWG, copper, solid.

.3 Conductor insulation: PO-Polyolefin.

.4 Outer jacket: Industrial Grade PVC.

.5 Temperature rating: -40°C to 75 °C.

.6 Flame test: CSA FT4.

.7 Approvals: CMG, CSA or equivalent.

.8 Manufacturer: Belden, 121872A or approved equal.

.9 Or approved equal.

2.8 PROFIBUS DP Cable – Armoured, Non-Hazardous Indoor Installation Only

.1 Requirements:

.1 Cable: to CAN/CSA-C22.2 No. 214.

.2 Type: Profibus DP Class A.

.3 Impedance: 150 Ohm nominal, 135 to 165 Ohm at frequency of 3 to 20 MHz.

.4 Cable capacitance: < 30 pF per meter.

.5 DC Resistance: ≤ 110 Ohm per km.

.6 Conductors: Copper, Solid, 0.326 mm^2 corresponding to 22 AWG.

.7 Conductor insulation: Red and green in colour.

.8 Geometry: 1 twisted pair, shielded.

.9 Shielding: Aluminum foil (tape) and tinned copper braid.

.10 Inner sheath: PVC, violet in colour.

.11 Armour: Continuously corrugated Aluminum armour.

.12 Outer jacket: PVC.

.13 Temperature rating: -30°C to 60°C.

.14 Voltage rating: 300 V.

.15 Flame test: CSA FT4.

.16 Approvals: CMG, CSA or equivalent.

.17 Manufacturer: Belden 183079A or approved equal.

2.9 PROFIBUS DP Cable – Armoured, Hazardous Location

.1 Requirements:

.1 Type: Profibus DP Class A.

.2 Impedance: 150 Ohm nominal, 135 to 165 Ohm at frequency of 3 to 20 MHz.

.3 Cable capacitance: ≤ 30 pF per meter.

.4 DC Resistance: ≤ 110 Ohm per km.

.5 Conductors: Copper, Solid, 0.326 mm^2 corresponding to 22 AWG.

.6 Conductor insulation: Red and green in colour.

.7 Geometry: one (1) twisted pair, shielded.

.8 Shielding: Aluminum/Polyester foil (tape) / 38 AWG tinned copper braided.

.9 Inner sheath: PVC, violet in colour.

.10 Armour: Interlocking aluminum armour.

.11 Outer jacket: PVC, violet in colour.

.12 Temperature rating: -40°C to 90°C.

.13 Voltage rating: 30 0V.

.14 Flame test: CSA FT4.

.15 Hazardous Location: HL-ABCD CSA or equivalent.

.16 Approvals: ACIC, CMG CSA or equivalent.

.17 Manufacturer: Turck 101550875 or approved equal.

2.10 PROFIBUS PA Cable – Non-Armoured

.1 Type: ISA/SP-50 Type A.

.2 Impedance: 100 Ohm nominal at 31.25 kHz.

.3 Cable capacitance: < 80 pF per meter.

.4 DC Resistance: < 44 Ohm per km.

.5 Conductors: Copper, Solid, 0.8 mm^2 corresponding to 18 AWG.

.6 Conductor insulation: Brown and blue in colour.

.7 Geometry: one (1) twisted pair, shielded.

.8 Shielding: Aluminum/Polyester foil (tape) / 38 AWG tinned copper braided.

.9 Outer jacket: PVC, orange in colour.

.10 Temperature rating: -40°C to 105°C

.11 Voltage rating: 600 V.

.12 Flame test: CSA FT4.

.13 Approvals: CIC/TC, CMG, CSA or equivalent.

.14 Manufacturer: Turck 101550785 or approved equal.

2.11 PROFIBUS PA Cable – Armoured

.1 Type: ISA/SP-50 Type A.

.2 Impedance: 100 Ohm nominal at 31.25 kHz.

.3 Cable capacitance: < 80 pF per meter.

.4 DC Resistance: < 44 Ohm per km.

.5 Conductors: Copper, Solid, 0.8 mm^2 corresponding to 18 AWG.

.6 Conductor insulation: Brown and blue in colour.

.7 Geometry: one (1) twisted pair, shielded.

.8 Shielding: Aluminum/Polyester foil (tape).

.9 Inner sheath: PVC, black in colour.

.10 Armour: Interlocked aluminum armour.

.11 Outer jacket: PVC, orange in colour.

.12 Temperature rating: -40°C to 105°C

.13 Voltage rating: 300 V.

.14 Flame test: CSA FT4.

.15 Hazardous Location: HL-BCD CSA or equivalent.

.16 Approvals: ACIC, CMG CSA or equivalent.

.17 Manufacturer: Turck 101550929 or approved equal.

3. EXECUTION

3.1 General

.1 Do not splice cables. A continuous length is required for all feeds.

.2 Install in accordance with manufacturer's recommendations, observing requirements for minimum bending radius and pulling tensions.

.3 Exercise care in stripping insulation from wire. Do not nick conductors.

3.2 Installation of Wires in Conduit

.1 Install in conduit as per Section 26 05 34, Conduits, Conduit Fasteners, and Conduit Fittings.

.2 Ensure conduit is dry and clean prior to pulling wire. If moisture is present, thoroughly dry conduits. Vacuum as required.

.3 Utilize wire-pulling lubricant.

3.3 Installation of TECK cable 0-600V

.1 Where surface mounted, provide clamps spaced a maximum of 1 m apart, unless otherwise indicated.

.2 Perform an insulation-resistance test on each conductor, prior to termination, utilizing a megohmmeter with a voltage output of 1000 volts DC. Individually test each conductor with all other conductors and shields grounded. The test duration shall be one minute. Investigate resistances less than 50 megaohms, or deviations between parallel conductors. Conductors with insulation resistance values, at one (1) minute, less than 25 megaohms, or that deviate from other similar conductors by more than 50% will be rejected.

3.4 Installation of Control Cables

.1 Install control cables in conduit or cable tray as indicated.

.2 Provide separation of cables from sources of noise, including other cables.

.1 For analog signals, provide separation distances as follows:

.1 120 VAC, 8 AWG and smaller: 100 mm.

.2 120 VAC, >8 AWG: 300 mm.

.3 600 VAC power: 300 mm.

.4 VFD or other high harmonic cable: 300 mm in metallic conduit/600 mm other raceway.

.5 Medium Voltage: 450 mm.

.2 For control signals < 50 V, provide separation distances as follows:

.1 120 VAC, 8 AWG and smaller: 50 mm.

.2 120 VAC, >8 AWG: 300 mm.

.3 600 VAC power: 300 mm.

.4 VFD or other high harmonic cable: 300 mm in metallic conduit/600 mm other raceway.

.5 Medium Voltage: 450 mm.

.3 For 120 VAC control signals, provide separation distances as follows:

.1 120 VAC, 8 AWG and smaller: none.

.2 120 VAC, >8 AWG: metal barrier or 150 mm.

.3 600 VAC power: metal barrier or 150 mm.

.4 VFD or other high harmonic cable: 150 mm in metallic conduit/300 mm other raceway.

.5 Medium Voltage: 450 mm.

.4 Advise the Contract Administrator if these separations cannot be achieved.

.3 Where surface mounted, provide clamps spaced a maximum of 1 m apart, unless otherwise indicated.

.4 Ground shields at one end only. Where possible, ground shields at the end where power is supplied to the cable. Utilize shield grounding bar in panels, where present, to ground overall shields. Individual pair shields to be grounded on appropriate terminals.

.5 Shield drain wires, at the ungrounded end, are to be taped back to the cable. Do not cut the shield drain wire off.

.6 CIC cable may not be installed in cable tray. Protection in conduit is required over the entire length.

.7 ACIC cable may be installed in cable tray, provided that:

.1 There is a barrier separating power and control cables within the tray, or

.2 The cable tray does not contain power cables, unless specifically authorized by the

.3 Contract Administrator in writing, and

.4 The ACIC cable voltage rating is equal or greater than the highest voltage contained in the cable tray.

3.5 Installation of Ethernet Copper Cables

.1 Where surface mounted, provide clamps spaced a maximum of 1 m apart, unless otherwise indicated.

.2 Provide separation of Ethernet cables from sources of noise, including other cables.

.1 Provide separation distances as follows:

.1 Instrumentation/Control < 50: 50 mm.

.2 120 VAC, 8 AWG and smaller: 100 mm.

.3 120 VAC, >8 AWG: 300 mm.

.4 600 VAC power: 300 mm.

.5 VFD or other high harmonic cable: 300 mm in metallic conduit/600 mm other raceway.

.6 Medium Voltage: 450 mm.

.2 Advise the Contract Administrator if these separations cannot be achieved.

.3 Ethernet cables may be installed in cable tray, provided that:

.1 There is a barrier separating power and control cables within the tray, or

.2 The cable tray does not contain power cables, unless specifically authorized by the Contract Administrator in writing, and

.3 The cable voltage rating is equal to or greater than the highest voltage contained in the cable tray.

.4 Prior to placing an Ethernet copper network into service, perform Ethernet copper cable test utilizing an approved testing equipment and provide complete test results to the Contract Administrator for review.

.1 Submit product datasheets of proposed testing equipment to the Contract Administrator for review prior to performing the test.

.5 Provide a lightning protection device whenever copper Ethernet cables are routed outside.

3.6 Installation of PROFIBUS Cables

.1 Where surface mounted, provide clamps spaced a maximum of 1 m apart, unless otherwise indicated.

.2 Provide separation of Profibus cables from sources of noise, including other cables.

.1 Provide separation distances as follows:

.1 Instrumentation/Control < 50: 50 mm.

.2 120 VAC, 8 AWG and smaller: 100 mm.

.3 120 VAC, >8 AWG: 300 mm.

.4 600 VAC power: 300 mm.

.5 VFD or other high harmonic cable: 300 mm in metallic conduit/600 mm other raceway.

.6 Medium Voltage: 450 mm.

.2 Advise the Contract Administrator if these separations cannot be achieved.

.3 Ground cable shields at every device, not at one end only.

.4 Where cables must cross, they should always do so at right angles.

.5 Provide a lightning protection device whenever Profibus cables are routed outside.

.6 Provide and install cable terminations as indicated on the drawings.

.7 Estimate trunk and spur cable lengths before they are installed and compare to the lengths shown on the drawings. Where actual lengths will be longer by more than 20% from lengths shown on the drawings, or where actual lengths will be longer than Profibus installation guideline maximums, inform the Contract Administrator. Total trunk cable length must be longer than the longest spur cable length for Profibus PA to minimize wave reflections.

.8 Do not mix different classes of cable or different manufacturers in the same segment.

.9 When installing the cables:

.1 Do not use excessive pulling force beyond the manufacturer’s specifications.

.2 Do not bend the cables beyond the manufacturer’s specifications.

.3 Do not twist the cables.

.10 Prior to placing a Profibus network into service, perform bus analysis of each segment utilizing an approved bus testing equipment and provide complete test results to the Contract Administrator for review.

.1 Submit product datasheets of proposed bus testing equipment to the Contract Administrator for review prior to performing bus testing.

3.7 Terminations and Splices

.1 Wire nuts are permitted only in the following circuits:

.1 Lighting circuits.

.2 Receptacle circuits.

.2 Exercise care in stripping insulation from wire. Do not nick conductors.

.3 Strictly follow manufacturer's instructions with regards to tool size and application methods of terminations and compounds.

.4 Where screw-type terminals are provided on equipment and instrumentation, terminate field wiring with insulated fork tongue terminals.

.5 Manufacturer: Thomas and Betts, Sta-Kon, or approved equal.

3.8 Reuse of Existing Wiring

.1 Except where specifically identified or approved, reuse of existing wiring is not permitted.

.2 Ensure all existing wiring is tagged prior to disconnection of equipment.

.3 Tag spare wires as “Spare” and indicate the location of the other end of the wire.

3.9 Installation in Conduit

.1 Utilize cable grips, appropriately selected to accommodate the type and geometry of the cable.

.2 Utilize cable pulling lubricant, compatible with the cable and conduit.

3.10 CABLE INDENTIFICATION

.1 Install cable tags at both ends of cable.

3.11 Testing

.1 Perform an insulation resistance test on all new and existing power conductors that are being terminated as part of the Work.

.2 Perform TIA-568-C.2 for category 6 cabling and connecting hardware on all ethernet cables. The installation will not be considered complete if it fails any of the tests even if communication is occurring.

.3 Perform bus analysis and waveform capture of all Profibus network segments and verify that there are no errors. The PROFIBUS installation will not be considered complete if it has communication errors even if communication is occurring.

END OF SECTION

1. GENERAL

1.1 Summary

.1 Section Includes:

.1 Process and HVAC instrumentation.

1.2 References

.1 National Electrical Manufacturers Association (NEMA).

.2 Canadian Standards Association (CSA International).

.3 Canadian Electrical Code (CEC).

.4 Canadian Underwriters Laboratory, Inc. (cUL).

.5 National Pipe Thread (NPT).

.6 International Protection Code (IP).

1.3 Submittals

.1 Submit Shop Drawings and manufacturer's installation instructions.

.2 Manufacturer's Instructions:

.1 Include manufacturer's installation instructions for specified equipment and devices in operation and maintenance manuals.

2. PRODUCTS

2.1 General

.1 Control devices of each category to be of same type and manufacturer.

.2 External trim materials to be corrosion resistant.

.3 Operating conditions: 0-35°C with 5-95% RH (non-condensing) unless otherwise specified for indoor components.

.4 All outdoor instrument and equipment to be rated for -40 to 40°C.

.5 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.

2.2 Outdoor/Indoor Temperature Element and Transmitter (Wall mount)

.1 Requirements:

.1 Sensor:

.1 3- wire RTD, Pt100.

.2 Probe length 120 mm.

.3 Probe diameter 6.25 mm.

.4 Measurement range: -200 to 850°C.

.5 Protective sheath for external mounting.

.2 Transmitter:

.1 Output signal: 4-20mA 2 wire with connection to HART.

.2 Accuracy: +/- 0.06°C.

.3 Enclosure:

.1 Transmitter is housed in a NEMA4X wall mount electrical enclosure with temperature element mounted externally.

.4 Operating Ambient Conditions:

.1 -40 to 85°C, 98% relative humidity with condensation.

.5 Approvals: CSA or equivalent.

.2 Acceptable Products:

.1 Siemens SITRANS TH300.

.2 This product was standardized by the City via RFP 449-2014.

2.3 HVAC Temperature Element and Transmitter (Pipe mount)

.1 Requirements:

.1 Sensor:

.1 3- wire RTD, Pt100.

.2 Probe length 120 mm.

.3 Probe diameter 6.25 mm.

.4 Measurement range: -20 to 85°C.

.5 Insertion type element.

.2 Transmitter:

.1 Output signal: 4-20mA 2 wire with connection to HART.

.2 Accuracy: +/- 0.06°C.

.3 Enclosure:

.1 Transmitter is housed in a NEMA4X electrical enclosure with temperature element mounted.

.4 Operating Ambient Conditions:

.1 -40 to 85°C, 98% relative humidity with condensation.

.5 Thermowell:

.1 Process Connection: 19 mm NPT(M) unless otherwise noted.

.2 Material: 316 stainless steel.

.3 Insertion Length: 89 mm minimum immersion.

.6 Approvals: CSA or equivalent.

.2 Acceptable Products:

.1 Siemens SITRANS TH300 or Magnetrol Autrol Series,

.2 This product was standardized by the City via RFP 449-2014.

2.4 Room Temperature Element and Transmitter

.1 Requirements:

.1 Sensor:

.1 Device box cover type 2- wire RTD, Pt100.

.2 Measurement range: 0 to 50°C.

.3 Stainless steel or Powder coated white steel.

.2 Transmitter:

.1 Output signal: 4-20mA 2 wire with connection to HART.

.2 Accuracy: +/- 0.06°C.

.3 Enclosure:

.1 Transmitter is housed in a NEMA4X electrical enclosure with temperature element mounted.

.4 Operating Ambient Conditions:

.1 -40 to 85°C, 98% relative humidity with condensation.

.5 Thermowell:

.1 Process Connection: 19 mm NPT(M) unless otherwise noted.

.2 Material: 316 stainless steel.

.3 Insertion Length: 89 mm minimum immersion.

.6 Approvals: CSA or equivalent.

.2 Acceptable Products:

.1 Siemens SITRANS TH300.

.2 Or approved equal in accordance with B7.

2.5 HVAC Temperature Switches

.1 Requirements:

.1 Functionality: Field adjustable with reference dials for each pole.

.2 Output: Qty 2, individually adjustable, DPDT dry contacts.

.3 Operating Temperature: -20 to 40°C minimum.

.4 Sensor: Local.

.5 Mounting: Duct.

.6 Enclosure Rating: NEMA Type 4X.

.7 Approvals: CSA or equivalent.

.8 Electrical Connections: Conduit: 19 mm NPT(F) unless otherwise noted.

.9 Material: 316 stainless steel.

.2 Acceptable Products:

.1 Ashcroft B-Series.

.2 United Electric B402-120.

.3 Or approved equal in accordance with B7.

2.6 Thermostat for HVAC applications

.1 General:

.1 Approvals: CSA or cUL.

.2 Industrial Grade.

.3 Type: Wall mount Thermostat.

.2 Enclosure:

.1 Hazardous locations, Class I Zone 2, Groups C, D.

.2 Explosion proof.

.3 Specifications:

.1 Temperature Rating: 2°C to 28°C

.2 Contact Type : SPDT, Snap Action.

.3 Electrical Rating: 120 VAC.

.4 Conduit connection: ¾" – 14 NPT.

.5 Manufacturer and Model:

.1 Ruffneck XT-312.

.2 Or approved equal in accordance with B7.

2.7 Temperature Gauge. Thermometer

.1 General:

.1 Function: Indicate process temperature.

.2 Type: Bi-metallic, circular dial.

.3 Parts: Temperature gauge and thermowell.

.2 Performance:

.1 Scale Range: As noted.

.2 Accuracy: 1% of full scale.

.3 Thermometer Features:

.1 Stem Length: 100 mm, unless otherwise noted.

.2 Stem Type: Every angle, unless otherwise noted. Adjustable 90 degrees vertical, 360 degrees horizontal.

.3 Dial:

.1 Heavy-duty glass, unless otherwise noted.

.2 125 mm circular, unless otherwise noted.

.3 Hermetically sealed.

.4 Construction: All-welded, stainless steel.

.4 Thermowell:

.1 Type: 13 mm NPT connection, Type 316 stainless steel.

.2 Extension Neck: When noted, with length as noted.

.5 Manufacturers:

.1 Ashcroft.

.2 WIKA.

.3 Or approved equal in accordance with B7.

2.8 Flow Element and Transmitter, Electromagnetic

.1 No alternates or substitutes will be accepted.

.2 All requests for purchase or quotation shall reference RFP 449-2014 to receive standardized pricing that the City has negotiated with the vendor.

.3 Manufacturer and Model:

.1 Siemens MAG6000 transmitter.

.2 MAG3100 flow tube, unless shown otherwise.

.3 This product was standardized by the City via RFP 449-2014.

2.9 Flow Element and Transmitter, Thermal Mass Flow

.1 General:

.1 Approvals: CSA or cUL

.2 Function: Directly measure, indicate, and transmit the mass flow of the gas in the duct or pipeline.

.3 Type: Insertion type, thermal dispersion detection probe using platinum resistance temperature detectors (RTD).

.4 Parts: Element and transmitter.

.2 Performance:

.1 Flow Turndown: As noted, to 100:1.

.2 Accuracy: Plus or minus 1% of reading or 0.5% full scale.

.3 Temperature, Operating:

.1 Flow Element: -40 to +30°C, unless otherwise noted.

.2 Transmitter Housing: -40 to +30°C.

.4 Pressure, Operating, Flow Element: Up to 10 000 kPa, unless otherwise noted.

.5 Integral temperature compensation for process temperature variation.

.3 Flow Element:

.1 Features:

.1 Insertion Length: As noted or as required by manufacturer's recommendation.

.2 Wetted Surfaces Materials: Type 316 stainless steel, unless otherwise noted.

.2 Process Connections:

.1 Connection Type: Threaded 25 mm (1") NPT full bore ball valve.

.2 Connection Material: Type 316 stainless steel, unless otherwise noted.

.3 Sensor Termination Enclosure: Aluminum, NEMA 4X, rated for Hazardous locations, Class 1 Zone 2, Group IIA; unless otherwise noted.

.4 Process Orientation: Horizontal, unless otherwise noted.

.4 Transmitter:

.1 Features: Minimum 2-line by 16-character LCD, keypad programmable.

.2 Signal Interface:

.1 Outputs: 4 to 20 mA with HART for maximum 600 ohm load, unless otherwise noted.

.2 Communication Protocols: Capable of both PROFIBUS DP and PROFIBUS PA.

.3 Provide communication protocol as shown on design documents.

.3 Power:

.1 Selectable: 115VAC, 230VAC, 24 VDC.

.2 Electrical Connection: 2 x 3/4-inch NPT.

.4 Transmitter Enclosure: Type: Aluminum NEMA 4X, unless otherwise noted.

.5 Mounting: Remote or integral to sensor.

.6 Cables: Supply cable as required between sensor and transmitter.

.7 Manufacturer and model:

.1 Endress and Hauser 65I.

.2 Or approved equal in accordance with B7.

2.10 Level Element and Transmitter, Ultrasonic

.1 No alternates or substitutes will be accepted.

.2 All requests for purchase or quotation shall reference RFP 449-2014 to receive standardized pricing that the City has negotiated with the vendor.

.3 Manufacturer and Models:

.1 Siemens Milltronics Multiranger 100 with XPS 15 sensor.

.2 Siemens Sitrans Probe LU.

.3 These products were standardized by the City via RFP 449-2014.

2.11 Level Transmitter, Submersible Hydrostatic

.1 General:

.1 Approvals: CSA or cUL.

.2 Function: Directly measure, indicate, and transmit level of process fluid.

.3 Type: Hydrostatic level measurement.

.2 Service: Wastewater, unless otherwise noted.

.3 Performance:

.1 Range: As noted.

.2 Temperature: –10 to +70°C.

.4 Features:

.1 Ambient Temperature Range (sensor): -10 to +70°C(for 42 mm diameter).

.2 Transmitter Material and Size: stainless steel housing, external diameter of 42 mm.

.5 Accessories: Terminal box IP66/IP67 with GORE-TEX filter.

.6 Signal Interface:

.1 Output: Analog 4 to 20 mA.

.2 Communication: HART 6.0 Protocol.

.7 Manufacturer and model:

.1 Endress and Hauser, Waterpilot FMX21.

.2 Or approved equal in accordance with B7.

2.12 Level Switch, Float

.1 General:

.1 Approvals: CSA or cUL.

.2 Function: Actuate contact at preset liquid level.

.3 Type: Direct-acting float with an enclosed switch and integral cable.

.2 Service: Wastewater, unless otherwise noted.

.3 Performance:

.1 Set Point: As noted.

.2 Temperature: 0 to 50°C.

.4 Features:

.1 Entire Assembly: Watertight and impact-resistant.

.2 Float Material and Size: Polyethylene/foam filled; 114 mm diameter max.

.5 Signal Interface: Switch Contacts: Form C Dry Contact rated 4.5 A continuous at 120 VAC.

.6 Manufacturer and model:

.1 Flygt ENM-10.

.2 Or approved equal in accordance with B7.

2.13 Level Controller – Sump Pit

.1 General:

.1 Approvals: CSA or cUL.

.2 Ratings: NEMA 4.

.3 Function: Mechanical Alternator – Contacts alternate closing when operating within first switch set points, when higher set point is reached, both contacts close.

.4 Temperature: -30 to 121°C.

.2 Service: Liquid; water, wastewater, unless otherwise noted.

.3 Switch Contacts:

.1 Isolated, rated 10A continuous at 120 VAC.

.2 Close on liquid rise.

.4 Float:

.1 Center Hole.

.2 Material: Stainless Steel.

.5 Manufacturer and Model:

.1 Square D 9038AW1.

.2 Or approved equal in accordance with B7.

2.14 Limit Switch – Clarifier Rake Sensor

.1 General:

.1 Approvals: CSA or cUL.

.2 Ratings: Explosion Proof.

.3 Function: Normally open and normally closed contacts that switch when the lever arm is actuated by the rotating clarifier scum trough rake.

.4 Temperature: -40 to 40°C.

.2 Service:

.1 Rated for wastewater application.

.3 Wiring:

.1 Wiring cable, fittings, and installation to be rated for explosion proof area.

.4 Manufacturer and Model:

.1 Rockwell Automation 802XR with 802MC-W3C lever arm.

.2 Or approved equal in accordance with B7.

2.15 Pressure Differential Switch

.1 General:

.1 Approvals: CSA or cUL.

.2 Function: Monitor differential pressure, and provide contact closure(s) when differential pressure is at the noted set point.

.3 Type: Diaphragm actuated.

.2 Performance:

.1 Set Point: Adjustable over the full range.

.2 Range: The noted set point shall fall between 20 and 80% of the range.

.3 Set Point Repeatability: Plus or minus 1.0% of range span.

.4 Maximum Pressure: Minimum 400% over range.

.3 Features:

.1 Actuator Seal: Buna-N, unless otherwise noted.

.2 Pressure Connection: Nickel-plated brass, unless otherwise noted.

.4 Process Connection: 6.35 mm NPT female connection, unless otherwise noted.

.5 Enclosure: NEMA 4X, unless otherwise noted.

.6 Signal Interface:

.1 Contact Type: SPDT, rated for 10 amps at 120 VAC.

.2 Hermetically sealed switch, if noted.

.7 Manufacturers:

.1 Ashcroft.

.2 United Electric.

.3 Or approved equal in accordance with B7.

2.16 Pressure Gauge

.1 General:

.1 Function: Pressure indication.

.2 Type: Bourdon tube.

.2 Performance:

.1 Scale Range: As noted.

.2 Accuracy: Plus or minus 0.50% of full scale.

.3 Features:

.1 Vibration Dampening: Required – Liquid filled or otherwise.

.2 Dial: 114 mm diameter, unless otherwise noted.

.3 Case Material: Black phenolic plastic, unless otherwise noted.

.4 Element Material: Phosphor-bronze, unless otherwise noted.

.5 Throttling Devices.

.1 Pulsation Dampener required, unless otherwise noted.

.2 Brass, unless otherwise noted.

.6 Pointer: Micrometer-adjustable.

.7 Movement: Stainless steel, teflon coated bearings, rotary geared.

.8 Window: Glass, unless otherwise noted.

.9 Socket Materials: brass, unless otherwise noted.

.10 Threaded reinforced polypropylene front ring for easy zero adjustment.

.11 Case Type: Solid front with solid wall between window and element. Rear of case, gasketed pressure relief.

.4 Process Connection:

.1 Mounting: Lower stem, unless otherwise noted.

.2 Size: 13 mm, unless otherwise noted.

.3 Connection Type: Threaded (NPT).

.5 Manufacturers and Products:

.1 Ashcroft.

.2 or approved equal in accordance with B7.

2.17 Pressure Switch

.1 General:

.1 Approvals: CSA or cUL.

.2 Function: Monitor pressure and provide contact closure(s) when pressure is at the noted set point.

.3 Type: Diaphragm sealed piston actuator.

.2 Performance:

.1 Set Point: Adjustable over the full range.

.2 Range: The noted set point shall fall between 30% and 70% of the range.

.3 Set Point Repeatability: Plus or minus 1% of range.

.3 Features:

.1 Diaphragm Material: Buna-N, unless otherwise noted.

.2 Pressure Connection: Stainless steel, unless otherwise noted.

.3 Reset: Automatic, unless otherwise noted.

.4 Enclosure: NEMA 4X, unless otherwise noted.

.5 Signal Interface: SPDT, snap action switch, rated for 15 amps at 120 VAC.

.6 Manufacturer and Model:

.1 Ashcroft B-Series,

.2 Or approved equal in accordance with B7.

2.18 Pressure Transmitter

.1 No alternates or substitutes will be accepted.

.2 All requests for purchase or quotation shall reference RFP 449-2014 to receive standardized pricing that the City has negotiated with the vendor.

.3 Provide factory installed block and bleed manifold, unless otherwise shown.

.4 Manufacturer and Model:

.1 Siemens Sitrans P 320.

.2 This product was standardized by the City via RFP 449-2014.

2.19 Pressure Transmitter – HVAC

.1 General:

.1 The measurement of room to atmospheric pressure.

.2 Local indication.

.2 Material:

.1 316 Stainless Steel

.3 Signal Interface:

.1 4-20 mA signal.

.4 Accuracy

.1 0.2% of span.

.5 Manufacturer and Model:

.1 Honeywell STD 700 Basic.

.2 Or approved equal in accordance with B7.

2.20 Density Meter

.1 General:

.1 Solids analyzers shall measure the concentration of the solids pumped through the process pipeline.

.2 316 stainless steel flangeless wafer-style flow-through in-line transmitter.

.2 Performance:

.1 Measuring range: 0-50% total solids.

.2 Repeatability: +/- 0.01% TS.

.3 Sensitivity: of +/-0.001%TS over the entire range.

.3 Features:

.1 Touch screen display 7 Inch.

.2 Interconnection cable: 10 M.

.3 Measuring range: 0-50% total solids.

.4 Repeatability: +/- 0.01% TS.

.5 Sensitivity: of +/-0.001%TS over the entire range.

.4 Enclosure:

.1 Sensor housing: NEMA 4X.

.5 Power supply: 120 VAC.

.6 Signal Interface:

.1 Input: 4 digital programable relay.

.2 Output: 2 4-20 mA.

.3 Communication: Profibus-PA.

.7 Manufacturer and Model:

.1 Valmet TS 4G CSA.

.2 Or approved equal in accordance with B7.

2.21 Horn

.1 General:

.1 Approvals: CSA or cUL.

.2 Function: Audible alarm.

.2 Performance:

.1 Temperature, Operating: -40 to+65°C.

.2 Sound Output Level: 100 dB nominal at 3 m.

.3 Features:

.1 Dimensions: 111 mm in height and width, and 63.5 mm in depth, for horn and enclosure.

.2 Diaphragm: Stainless steel.

.3 Projector: None, unless otherwise noted.

.4 Enclosure: Type: Corrosion resistant NEMA 4X.

.5 Voltage: 120 VAC, 60 Hz, unless otherwise noted.

.6 Current: less than 0.2 A.

.7 Manufacturers:

.1 Federal Signal 350WB.

.2 Or approved equal in accordance with B7.

2.22 Warning Light, Strobe

.1 General:

.1 Approvals: CSA or cUL.

.2 Function: Visual alarm.

.3 Type: Rotating reflector or flashing bulb.

.4 Provide means to synchronize flashes within corridors or rooms in the same field of view.

.2 Performance:

.1 Temperature, Operating: -37 to 87°C.

.2 Flash Rate: Minimum 80 per minute.

.3 Light Intensity: 800,000 candela or greater.

.3 Features:

.1 Dome Colour: Red, unless noted otherwise.

.2 Lamp Life: 60,000 hours minimum.

.3 Lamp: LED.

.4 Enclosure:

.1 Type: Corrosion resistant NEMA 4X.

.2 Mounting: Wall bracket, unless otherwise noted.

.3 Indoor/outdoor use.

.5 Voltage: 120 VAC, 60 Hz, unless otherwise noted.

.6 Current: less than 0.2 A.

.7 Manufacturer and model:

.1 Federal Signal SLM100.

.2 Or approved equal in accordance with B7.

2.23 Door Switch

.1 General:

.1 Approvals: CSA or cUL.

.2 Function: Monitor intrusion of standard door.

.3 Type: Magnetic, indoor use.

.4 Parts: Magnet on door, switch on door frame.

.2 Features:

.1 Type: Aluminum housing with 914 mm (36”) armored cable, unless otherwise noted.

.2 Gap Distance/Type: 76 mm (3”) Make.

.3 Signal Interface.

.1 Voltage: 24 VDC.

.2 Contact Type: SPDT.

.3 Contact Rating: 0.25 A @ 24 VDC.

.4 Connection: 914 mm (36”) lead wires.

.4 Manufacturer and model:

.1 GE Security 2507A.

.2 Or approved equal in accordance with B7.

2.24 Motion Detector

.1 General:

.1 Approvals: CSA or cUL.

.2 Function: Monitor occupancy.

.3 Type: Dual Technology Ultrasonic and Passive Infrared.

.2 Features:

.1 Type: plastic Casing.

.2 Coverage: 150 square meter (1600 square feet).

.3 Mounting: Mounting base provided.

.4 Operating temperature: 0° to 40°C

.5 Relative humidity: 0% to 95%.

.6 Power Requirements: Voltage: 24 VDC.

.3 Signal Interface.

.1 Voltage: 24 VDC.

.2 Contact Type: SPDT.

.3 Contact Rating: 500 mA @ 24 VDC.

.4 Manufacturer and model:

.1 Hubbell LODTRP.

.2 Or approved equal in accordance with B7.

2.25 Grinder Pump Level Control Switch

.1 General:

.1 Provide an integral alternating pump control switch rated for wastewater applications.

.2 The pump controller will activate the output contacts based on the float position.

.3 Configure the start and stop height of the pump controller based on the sump pit high and low/empty levels.

.2 Manufacturer and Model:

.1 Pedastal Mounted mechanical alternator Square D Pumptrol 9038AG1C complete with float kit Schneider Electric 9049A6.

.2 Or approved equivalent as per Section B7.

2.26 Card Access Reader

.1 General:

.1 RFID Card Reader with 2.5”-4” range or better.

.2 -55C to 85C Operating temperature.

.3 Must be compatible with existing plant RFID card access system.

.4 Integrate new Card Readers with the existing Card access system. Work with the City to configure access.

.1 Electrical room shall only be accessible by the AICG and EI staff; all other rooms shall be accessible by all plant staff.

.5 Test and demonstrate to the Contract Administrator cards of different access levels and incorrect card types.

.2 Manufacturer and product line:

.1 HID multiCLASS SE RP40

3. EXECUTION

3.1 Installation

.1 Install equipment and components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.

.2 Install field control devices in accordance with manufacturer's recommended methods, procedures, and instructions.

.3 Support field-mounted panels, transmitters, and sensors on pipe stands or channel brackets.

.4 Electrical:

.1 Complete installation in accordance with Section 40 90 00 and 26 05 00.

.2 Install communication wiring in conduit or utilizing ACIC cabling if shown on the Drawings.

.1 Provide complete conduit/cable system to link instrumentation and the control panel(s).

.2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.

.3 Maximum conduit fill not to exceed 40%.

.4 Design Drawings do not show conduit layout.

3.2 Temperature Sensors

.1 Stabilize to ensure minimum field adjustments or calibrations.

.2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.

.3 Duct installations:

.1 Do not mount in dead air space.

.2 Locate within sensor vibration and velocity limits.

.3 Securely mount extended surface sensor used to sense average temperature.

.4 Thermally isolate elements from brackets and supports to respond to air temperature only.

.5 Support sensor element separately from coils or filter racks.

.4 Averaging duct type temperature sensors.

.1 Install averaging element horizontally across the ductwork starting 300 mm from top of ductwork. Each additional horizontal run to be no more than 300 mm from the one above it. Continue until complete cross sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.

3.3 Pressure Switches and Transmitters

.1 Install in a manner to allow easy removal of the transducer and cable assembly for maintenance purposes.

.2 Survey and document the exact elevation of the pressure transmitter installation.

3.4 Differential Pressure Transmitter

.1 Install a valve and tee on each line coming into transmitter to allow tubing to be blown out.

3.5 Identification

.1 Identify field devices with lamacoids. Install in a conspicuous location.

3.6 Testing and Commissioning

.1 Calibrate and test field devices for accuracy and performance in accordance with Section 40 99 92 – Automation Testing and Commissioning.

3.7 TRAINING

.1 Provide one (1) 4-hour training for instrument including but not limited to items listed in specification Section 40 91 01.

END OF SECTION

1. GENERAL

1.1 Description

.1 Design, supply, and installation programmable logic controller (PLC) and Remote IO (RIO) based control panels for each process area in accordance with the requirements of these Specifications and associated drawings.

.2 Terminal blocks and associated components shall be housed in the same control panel as the associated IO Card.

.3 Development of the PLC programs and integration of the new area PLCs into the main Process Control System (PCS) are to be provided under this contract.

.4 PLCs will be Schneider Electric Modicon M580 as per the City's Standardized Agreement in Appendix A (RFP-756-2013). All PLCs shall be sourced through the Standardized Agreement at the City's negotiated costs.

.1 Reference RFP-756-2013 to receive standardized pricing.

1.2 Submittals

.1 Submit the following in accordance with Section 01 33 00, 40 95 13 Control Panels, and 40 96 00 Application Software:

.1 For each component and material submit shop drawing which shall include:

.1 Manufacturer.

.2 Model number.

.3 General data and description.

.4 Engineering specifications and data sheets.

.5 Catalog cuts.

.6 For information purposes only, submit manufacturer's printed installation instructions.

.2 For each process area submit a detailed PLC network diagram that show the PLC rack configuration and connections including redundant connections to the PCS.

.3 Standardized Programmable Logic Blocks

.1 Some existing standardized programmable logic blocks may be provided by the City. Use the pre-existing blocks where applicable.

.2 Submit documented copies of the standardized programmable logic blocks.

.3 Limit the size and complexity of function blocks to provide generic usage across multiple process areas. Base functionality of equipment shall be included within the standardized blocks. Process specific checks and calculations shall occur outside of the standardized function blocks and pass through to the standardized block as a generic input or output.

.4 Documentation shall at a minimum include all details to understand the operation of all aspects of the logic block including:

.1 Inputs.

.2 Outputs.

.3 Intermediate Signals or Variables.

.4 Data types.

.5 Access Modifiers.

.6 Control Response.

.7 Compound Control Response.

.8 Error Catching and Correction.

.9 Limits.

.10 Setpoints .

.5 Demonstrate all standardized programmable logic blocks.

1.3 Quality Assurance

.1 Provide in accordance with Section 01 45 00 and as specified.

1.4 Delivery, Storage and Handling

.1 Provide in accordance with Section 01 61 00 and as specified.

1.5 Equipment Identification

.1 Each PLC rack shall be tagged and labelled with lamacoid labels on the panel backboard where visible after wires are connected.

.1 If labels are obstructed by wires, provide and field install new lamacoid labels.

1.6 Warranty

.1 The Contractor shall warrant that all materials and equipment furnished under the Contract are in good working order, free from defects, and in conformance with system specifications. All installed equipment shall conform to the manufacturer's official published specifications. The warranty shall begin at the system acceptance date and remain in effect for a period of

one (1) year from that date. The Contractor shall agree to repair, adjust, and/or replace (as determined by the Contract Administrator to be in its best interest) any defective equipment, materials, or other parts of the system at the Contractor's sole cost. The City will incur no costs for service or replacement of parts during the warranty period of one (1) year. All third party warranties shall be passed through from the Contractor to the City.

.1 The system acceptance date shall be unique for each area based upon the successful completion of the switchover, commissioning, training, demonstration period, and O&M and as-built submittals for that work.

.2 The Contractor shall warrant that all programmable logic developed for the project shall be free from defects leading to unintended operation of the plant equipment. The programmable logic will be based on the Process Control Narratives and the existing DCS logic to replicate the existing control loops. The warranty shall begin at the system acceptance date and remain in effect for a period of one years from that date. The Contractor shall agree to repair or adjust the programmable logic if defects are found. The Contractor shall expedite the repair or adjustments to the level of severity to ensure no additional damages occur to the plant, personnel, or treatment capacity occur. All repairs or adjustments will not take longer than one (1) calendar month to complete from the time of notice.

.1 The City shall be allowed to make urgent or required corrections to the programmable logic to benefit the plant at their discretion. Adjustment to portions of the programmable logic does not remove the warranty coverage for any of the existing code produced by the contractor.

.3 The Contractor shall warrant and supply evidence that the installation of materials and hardware will be made in strict compliance with all applicable provisions of the Canadian Electrical Code.

.4 The Contractor shall warrant that the system will function in accordance with the manufacturer’s published technical description guide.

2. PRODUCTS

2.1 Manufacturers

.1 PLCs and RIO Hardware:

.1 Use standardized products by the City via RFP 756-2013.

.2 No alternates or substitutes will be accepted.

.3 Part or Model numbers shall be as shown on Automation-Cabinet Layout drawings.

.4 Provide all required hardware for a complete installation.

.2 PLC Software:

.1 Use standardized products by the City via RFP 756-2013.

.2 No alternates or substitutes will be accepted.

.3 See Section 40 96 00, Application Software for requirements.

2.2 Accessories

.1 Include the following accessories:

.1 RJ45 connection cable for Modbus port on CPU.

2.3 USB Memory Stick

.1 Provide a USB memory stick for each process area with the following:

.1 Latest PLC, HMI, and other applications programs and accompanying documentation.

.2 PLC, HMI, and any other used software and hardware manuals

.2 Provide the memory stick as per Section 2.3.1 to the Contract Administrator prior to the commencement of any area commissioning activities.

.1 When emergency updates are pushed to the PLCs, HMIs, or other application programs, provide the Contract Administrator updated copies as soon as possible.

.3 Provide the memory stick as per Section 2.3.1 to the Contract Administrator prior to the any area handover, the USB to include as left programs for PLC, HMI, and other applications programs and accompanying documentation.

2.4 Spare Parts

.1 Provide one (1) spare PLC processor card of each type used in the project.

.2 Provide two (2) spare PLC cards of each type used in the project, other than processor cards.

.3 Provide one (1) spare backplane of each type used in the project.

.4 Provide one (1) spare communication module of each type used in the project.

.5 Provide two (2) power supply modules of each type used in the project.

.6 Provide one (1) pre-manufactured fly wire cable for each card type.

.7 A complete set of the spare parts will be available at the beginning of commissioning each panel.

3. EXECUTION

3.1 General

.1 Install the PLCs and RIOs as per manufacturer instructions and recommendations and as shown on the drawings.

.2 Follow Cabinet Layout drawings for hardware layout.

3.2 Firmware and Software Versions

.1 Update the firmware of each PLC card to the version agreed upon with the City prior to the FAT and SIFT.

.1 Updating of firmware after the FAT and SIFT requires the agreement from the City and submission of a test and validation plan. The test and validation plan shall demonstrate every part of the application software impacted by the firmware.

.2 The Contractor shall inform the Contract Administrator of any new firmware or software updates issued by the manufacturer after FAT and SIFT. The Contractor shall inform the Contract Administrator if the installation of the new firmware or software update is required by the manufacturer.

.1 Testing and verification due to firmware or software updates shall be performed at no additional cost.

3.3 PLC Programming Services

.1 PLCs shall be programmed following the guidance of the City of Winnipeg's Automation Design Guide, see appendix A.

.2 Use the manufacture's default software blocks where applicable.

.3 Predefined custom City of Winnipeg logic blocks may be provided for use in the project. City of Winnipeg custom logic blocks shall be used in cases where their function applies.

.4 Hot/Standby PLCs shall allow for Offline Application with Allowed Application Mismatch.

.5 PLC program design and structure shall allow for live troubleshooting, including forcing of I/Os, without losing automated PLC control of the plant.

.6 PLC functions shall be developed with coordination of the HMI screens and the HMI and Automation Layout Plan to ensure the PLC functionality is able to be interfaced with HMI while adhering to the user interface requirements.

.7 Produce, submit for review, and use custom standardized programmable logic blocks as templates throughout project development.

.1 Submit the standardized programmable blocks in a form that is easily imported to Schneider Electric EcoStruxure Control Expert.

.8 Standardized programmable logic blocks shall be created for any combination of logic (for example, a pump control loop) that is used throughout the entire project five (5) or more times.

.1 Plan and submit the standardized programmable logic blocks during the PCS configuration stage.

.2 Retroactively create and submit standardized programmable logic blocks if the usage meets and exceeds the usage threshold. Update prior logic as required. The City may waive the requirement to update and re-commission prior logic.

.3 The City may waive the requirement for any individual logic block to become a standardized programmable logic block at their discretion.

.9 Use testing variables to enable and disable logic sections at a time during the switchover events. Ensure the testing variable status is clearly visible on the relevant HMI screens.

.10 Organize the program structure in a logical order and groupings to maximize the clarity of the program logic and enhance debugging ability.

.1 Where compound control loops are used that involve multiple stages, multiple feedback loops, or spans multiple sheets, provide sufficient documentation to describe the program functionality clearly. Reference the control blocks, functions, inputs, and outputs as needed.

.11 Remove forced values from the final version of the programs before commissioning.

.12 Daily (24 Hours) totals begins 08:00 AM CST and ends 08:00 AM CST next day.

.13 See Section 40 96 00, Application Software for additional requirements.

.14 Use DTM for device configuration and communication.

3.4 Time Synchronization

.1 Set up the NOC and processor cards NTP client's to use the HMI Server and the NTP server.

.1 Set the maximum time interval to as long as possible in up to 1024 seconds. Reduce the time interval if required for process application.

3.5 PLC Commissioning Services

.1 Provide all required PLC and RIO commissioning services as per Section 40 99 92 - Automation Testing and Commissioning.

3.6 City Access

.1 Designated City personnel shall be given super-user administrative access to all live system components to facilitate and maintain the plants treatment capabilities throughout the entire project duration.

.1 A Field Instruction will be provided to the Contractor each incident the City is required to modifying the working applications to maintain plant functionality.

.2 The Contractor may maintain the City's changes or can implement their own correction.

3.7 Contract Closeout

.1 Provide in accordance with Section 01 78 00.

END OF SECTION

1. GENERAL

1.1 Description

.1 Provide materials and fabrication of custom control panels as indicated and in compliance with Contract Documents.

.2 Panels shall incorporate controls and protection devices as shown on the Contract Documents.

.3 All panels shall be built by a CSA/cUL approved panel shop or manufacturer. Each panel shall bear the CSA/cUL seal with the manufacturer's file number.

.4 All new panels shall be factory assembled and pre-wired. Factory Acceptance Tests (FATs) and System Integration Functional Tests (SIFTs) as per Section 40 99 91 shall be performed and witnessed and accepted by the Contract Administrator prior to shipping any panels.

.5 Supply, install, wire and test all components inside the Control Panels according to the specifications herein and the drawings.

.6 Any panels that are substantially modified from the original installation shall be inspected by an authorized CSA/cUL inspector and have a new CSA/cUL applied. Perform any required updated to substantially modified panels to meet the CSA/cUL requirements.

1.2 Submittals

.1 Submit the following in accordance with Section 01 33 00:

.1 For each component and material submit Shop Drawing which shall include:

.1 Schematic diagrams shall show the equipment serial or tag number, the City's drawing number, contract number, or similar identification which will indicate the particular equipment to which the diagrams apply. Diagrams shall show all equipment in the electrical system including internal wiring of subassemblies. Diagrams of subassemblies may be furnished on separate sheets.

.2 Wiring and interconnection diagrams shall show all wire connections to device terminals, terminal blocks, and all wiring within the panel. No more than two wires shall be shown connected to any one terminal. Terminals shall contain unique identifiers. All signals shall be able to be fully traced on the drawings.

.3 Identify each device by a unique number or number-letter combination.

.4 Detailed IO module wiring diagrams.

.5 Detailed loop diagrams of connections to Field Device Panels, Termination Panels, Marshalling Panels, and HVAC Panels.

.6 Show spare contacts.

.7 Panel Layout drawings.

.8 Complete Bill of Materials.

.9 Configuration/parameter sheets including switch settings, parameter settings, and addresses. Show factory default settings and proposed settings.

.10 Diagram showing dip switches complete with proposed settings.

.2 Submit Shop Drawings for approval prior to panel fabrication.

.3 Keep updated red line drawings of each panel in each control room during area migrations.

.4 Provide as-built drawings at the end of the area migration of the panel including detailed IO module wiring diagrams, panel layouts, panel power distribution schematics, and detailed loop drawings.

.1 As-built drawings to adhere to the City of Winnipeg CAD Drafting Manual and the WWD CAD/GIS Standards.

1.3 Quality Assurance

1.4 Inspection

.1 Provide in accordance with Section 01 45 00 and as specified.

.2 A factory inspection of the control panels will be performed at the discretion of the Contract Administrator based upon the pre-shipment submittals.

.3 Demonstrate and test the control panel in the presence of the Contract Administrator designated representative as part of the FAT and SIFT.

1.5 Delivery, Storage and Handling

.1 Provide in accordance with Section 01 61 0 and as specified.

.2 Transportation method to site shall be in an air ride van or equivalent.

1.6 Equipment Identification

.1 Each Panel shall be tagged with lamacoid labels on the panel backboard where visible after wires are connected.

.2 Each panel shall have a CSA certification nameplate.

1.7 Warranty

.1 The Contractor shall warrant that all materials and equipment furnished under the contract are in good working order, free from defects, and in conformance with system specifications. All installed equipment shall conform to the manufacturer’s official published specifications. The warranty shall begin at the system acceptance date and remain in effect for a period of one years from that date. The Contractor shall agree to repair, adjust, and/or replace (as determined by the Contract Administrator to be in its best interest) any defective equipment,

materials, or other parts of the system at the Contractor's sole cost. The City will incur no costs for service or replacement of parts during the warranty period of five (5) years. All third-party warranties shall be passed through from the Contractor to the City.

.2 The Contractor shall warrant and supply evidence that the installation of materials and hardware will be made in strict compliance with all applicable provisions of the Canadian Electrical Code.

.3 The Contractor shall warrant that the system and individual parts will function in accordance with the manufacturers' published technical description guide.

2. PRODUCTS

2.1 Manufacturers

.1 Devices of each function shall be of the same type and manufacturer.

2.2 Enclosures

.1 Design and test control enclosures in conformance with C22.2 Nº286. Enclosure types shall be as follows unless noted otherwise in the drawings or specifications:

.1 Indoor use, non process area: NEMA Type 12.

.2 Outdoor use or process area: NEMA Type 4.

.3 Corrosive area: NEMA Type 4X.

.2 The depth of the control enclosure or compartment shall be a minimum consistent with the maximum depth of the control devices plus the required electrical clearance. In no case shall the depth of the enclosure be less than 200 mm.

.3 Provide mounting panel for mounting of interior components. Panel finish shall be white enamel.

.4 Where heating from control devices results in a temperature rise which is detrimental to the contained equipment or its operation, provide louvers or forced air ventilation. Design ventilating openings to prevent the entrance of any deleterious substance. When forced air ventilation is required, the cabinets shall be pressurized. Air filters shall be of commercially available types and sizes.

.5 Provide a permanent metal data pocket attached to the inside of the enclosure. If space permits, the pocket shall be at least 250 mm wide and of depth and thickness to accommodate electrical diagrams.

.6 Enclosure construction shall be minimum 14 gage steel. Finish shall be white enamel inside and gray prime outside over phosphatized surface. Provide continuous hinges for enclosure doors with external screw clamps. Provide hasp and staples for padlocking.

Control panels shall be provided with heating, ventilation, and/or cooling as required to ensure the internal temperature and humidity are maintained at acceptable levels for the components within.

.1 Perform a heat-load analysis for all control panels containing heat-generating components. Determine if the thermal dissipation via the enclosure walls is sufficient or if additional cooling is required. If additional cooling is required, consider installing filtered louvers at opposite corners of the control panel to provide cooling through natural convection. If natural convection is insufficient, install a filtered fan unit to provide forced air flow through the panel.

.2 Where fans are provided on control panels, ensure that the fans positively pressurize the cabinet to prevent ingress of contaminants through small openings. The air used to positively pressurize the cabinets must be from a clean source.

.7 Manufacturer:

.1 Hoffman Proline enclosures.

.2 Or approved equivalent.

2.3 Components

.1 All components are to be DIN Rail Mounted.

.2 DIN Rail style TS 35 mm, slotted.

.1 When used to mount terminals, use straight risers such that the top of the terminals are at the same height as the wiring duct.

2.4 Control Wiring

.1 120-volt control wiring shall be Type MTW, THWN, or THHN. Conductors shall not be smaller than No. 14 AWG. Ampacity shall be in accordance with the CEC.

.2 Instrumentation signal cables shall be of the type used for field wiring.

.3 Wire and cable insulation shall be flame retardant.

.4 High flexible stranding type wire shall be used in restricted spaces or across hinged sections.

.5 Wire colour to follow the City of Winnipeg's Automation Design Guide, Electrical Design Guide, and Identification Design Guide.

2.5 Marking

.1 Identify wire terminations with a number to correspond with the schematic diagrams. Identification tags shall be preprinted white heat-shrinkable tubing, Raychem Thermofit TMS.

.2 Plainly and permanently identify control and power devices using the same identification as shown on the schematic diagrams. Show identification for devices inside the enclosure on a plate adjacent to, not on, the device.

2.6 Supply Circuit Disconnecting Means

.1 Provide a supply circuit disconnect for each control panel. Disconnect shall be a circuit breaker mounted within the control enclosure operated by a variable depth flange-mounted circuit breaker operating mechanism.

2.7 Wiring Methods

.1 Panel wiring shall be neatly contained in narrow-slot ventilated wireways, including incoming and outgoing field control wiring. Wireways shall be light gray coloured, restricted slot design, with matching snap-on covers. Use light blue coloured wireways for intrinsically safe wireways. Provide wireways with mounting holes and nylon "push" rivets for mounting. Wireways material shall be PVC or noryl.

.1 Size wireways such that they are not more than 40% full once the wiring is installed.

.2 Provide minimum 50 mm of clearance between wireway and wire terminations to allow for clear viewing of wire identification marking.

.3 Provide the mandatory ventilation clearances around heat-generating components as specified by the component manufacturer. Indicate mandatory component clearances on the panel layout drawings.

.4 Tie wiring run to control devices on the front door together at short intervals and secure to the inside front door with adhesive mounts. Mounts shall be adjustable releasable-clamp type for wire bundles 17 mm in diameter or smaller or releasable nylon cable ties for bundles larger than 17 mm in diameter. Attach mounts to front panel with adhesive.

.5 Provide a minimum of 19 mm separation between ventilated wireways containing intrinsically safe wiring and ventilated wireways containing non-intrinsically safe wiring.

.6 Categorize and group conductors based on their application. Provide separate wireways for conductors of each category in order to minimize electromagnetic interference. Categories 3 and 4 may be combined if space is limited.

.1 Category 1: AC Power and Control:

.1 AC Power for power supplies.

.2 120 VAC Control Wiring.

.3 24 VAC Control Wiring.

.2 Category 2: DC Power and Control:

.1 DC Power.

.2 DC Control Wiring.

.3 Category 3: Analog Signals:

.1 Analog I/O.

.4 Category 4: Communications:

.1 Communication Cables.

2.8 Terminal Blocks

.1 Provide enough terminal blocks for designed requirements including indicated spares. Wire all spare terminal blocks back to PLC or RIO cards.

.1 One terminal block shall be provided for each wire entering or exiting the control panel.

.2 No more than two wires shall terminate on the same terminal.

.2 Provide screw clamp compression terminals in style shown on drawing. Approved manufacturer:

.1 Phoenix Contact.

.3 Ground Terminals shall be electrically grounded to the mounted DIN rail.

.4 Provide fifteen (15) spare terminal blocks of each type for the project.

2.9 Ground Bar

.1 Provide Electric and Instrument Ground bus bars for each panel. Connect Electric and Instrument ground bus bars at circuit location nearest the panel external ground connection.

.2 Connect only instrument grounds to the Instrument Ground bus bar.

.3 Bus bars to have pre-tapped holes with screws. Size for 25% spare capacity, maximum one wire per screw.

2.10 Pushbuttons

.1 Schneider Type K or SK or approved equivalent.

2.11 Pilot Light

.1 Push to test.

.2 Schneider Type K or SK or approved equivalent.

2.12 PLC and RIOs

.1 See Specification Section 40 94 43.

2.13 Dual Ring Switches

.1 Provide dual ring switches for networked IO as shown on Automation-Cabinet Layout drawings.

.2 Modicon Extended Managed Switch 8TX (MCSESM083F23F1). No alternates or substitutes will be accepted.

.3 Provide all required hardware for a complete installation.

2.14 Relays

.1 Phoenix Contact PLC-RSC Series.

.2 Or approved equivalent.

2.15 Signal Conditioning Module

.1 Where required, provide signal conditioning modules which comply with the following requirements:

.1 Analog signal inputs: 4-20 mA DC into 500 ohms or less.

.2 Analog signal outputs: 4-20 mA DC into 500 ohms.

.3 Discrete output contacts: SPDT or DPDT rated 5A.

.4 Arrange electronic trips so that output contact opens in case of loss of signal or loss of power supply.

.5 Signal conditioning and isolating modules to be rated for continuous operation in an ambient temperature of 0 to 80°C. The ambient temperature effect on module accuracy is not to exceed plus or minus 0.01% per °C within that range.

.6 Span and zero adjustments to be made by front accessible multi-turn potentiometers.

.7 Provide electronic trip modules with LED indicators for relay status.

.8 Signal conditioning modules to withstand 30 V per meter radio frequency radiation between 200 and 500 MHz with not more than 0.25% calibration effect. Provide modules with traps on the terminals to shunt conducted radio frequency interference to ground.

.9 Provide effective isolation of signal and power supply terminals from the case.

2.16 Power Supplies

.1 Provide all DC power supplies as required for all instrument circuits. Power all circuits from the local control panels or marshalling panels. Power supplies to be equal to Hammond or G.F.C., complete with an overvoltage protection module.

.2 Provide redundant configurations for power supply equipment serving more than one instrument loop, so that failure of a single unit will not disable all or any shared part of the instrumentation and communication system. Provide diode isolation for redundant direct current supply units and ground the negative terminal of the power supply.

.3 Unless otherwise required, all DC power supplies to be rated 24 VDC, adjustable ±20%, and set to provide 24 V on the panel direct current bus. Size the power supply for two times the connected load, minimum size is 2 amps.

2.17 UPS Power Supply

.1 Provide an online un-interruptible power supply (UPS) in each control panel that is not fed by an external UPS.

.2 UPS to provide the following inputs to the PLC:

.1 On Battery Status.

.2 Fault.

.3 Size UPS standby capacity for 60 minutes at full load rating. UPS size shall be no lower than shown on the drawings.

.4 Provide on-line units, acceptable manufactures:

.1 Phoenix Contact,

.2 Toshiba,

.3 Or approved equal.

2.18 Lighting

.1 Provide lighting for all panels.

.2 Fixture mounting: top-centre of enclosure, unless otherwise noted.

.3 Lights: LED, white.

.4 Power supply: 24 VDC.

.5 Manufacturer:

.1 Hoffman.

.2 Or approved equivalent.

2.19 Spare Parts

.1 Provide ten (10) spare fuses for each panel of each rating type. Store in resealable plastic bag inside panel document holder.

3. EXECUTION

3.1 General

.1 Construct panels in conformance with C22.2 N^{o}286.

3.2 Wiring

.1 Wire panels as shown in the contract drawings and as per the Shop Drawing.

.2 All wires and cables inside the control panels shall be identified on both ends using permanent labels. Labels shall be machine printed; handwritten labels shall not be accepted. Utilize heat shrink labels where practicable.

.1 Wire labels shall match the drawing labels.

.2 Wire terminations and connections shall match the drawings and schematics.

.3 All individual conductors shall be labelled.

.3 No splices shall be used while wiring the panel.

3.3 Grounding

.1 All control panel components shall be adequately grounded in accordance with the component manufacturer's instructions, especially control system components.

.2 Bond all devices to the panel ground bus bar.

3.4 Terminals

.1 Jumper bars shall be used where possible instead of jumper wires.

3.5 Testing

.1 Test the control panel prior to the FAT. Provide a check list of the tests performed and results.

.2 Tests to include at a minimum:

.1 Power supply functionality.

.2 PLC and RIO processor and card functionality.

.3 Loop checks of all circuits.

.4 Relay and switch functionality.

.5 Receptacle and lighting functionality.

.6 All networking functionality.

3.6 Factory Acceptance Tests

.1 Perform Factory Acceptance Tests and System Integration Functionality Tests as specified in Section 40 99 91.

3.7 Inspection

.1 Inspect all panels after delivery to ensure no signs of damage from transportation. Inspect wires for loosened terminations.

.2 Notify the Contract Administrator and replace any component damaged in transportation.

3.8 Contract Closeout

.1 Provide in accordance with Section 01 78 00.

END OF SECTION

1. GENERAL

1.1 Description

.1 Provide a new PCS Operator Workstation shown on the drawings with required software installed and configured.

1.2 Submittals

.1 Submit in accordance with Section 01 33 00.

1.3 Quality Assurance

.1 Provide in accordance with Section 01 45 00 and as specified.

1.4 Delivery, Storage and Handling

.1 Provide in accordance with Section 01 61 00 and as specified.

1.5 Equipment Identification

.1 Each Workstation shall be tagged with lamacoid labels on the device enclosure in a spot that is visible.

.1 Labels shall not block visibility of any screens, components, fasteners, or nameplates. If a suitable location cannot be found, notify the Contract Administrator.

1.6 Warranty

.1 The Contractor shall warrant that all materials and equipment furnished under the contract are in good working order, free from defects, and in conformance with system specifications. All installed equipment shall conform to the manufacturer’s official published specifications. The warranty shall begin at the system acceptance date and remain in effect for a period of one years from that date. The Contractor shall agree to repair, adjust, and/or replace (as determined by the Contract Administrator to be in its best interest) any defective equipment, materials, or other parts of the system at the Contractor's sole cost. The City will incur no costs for service or replacement of parts during the warranty period of one (1) year. All third party warranties shall be passed through from the Contractor to the City.

.2 The Contractor shall warrant and supply evidence that the installation of materials and hardware will be made in strict compliance with all applicable provisions of the Canadian Electrical Code.

.3 The Contractor shall warrant that the system and individual parts will function in accordance with the manufacturers’ published technical description guide.

2. PRODUCTS

2.1 Software

.1 Provide all software and licenses for a complete and operational system. Install and set up all licenses on hardware specified.

.1 Maintain licenses for the entire duration of the project.

.2 Provide the Contract Administrator with a list every three (3) months of current software licences, account information, expiration dates, renewal information and costs.

.1 License information shall be included in the final O&Ms.

.3 Before installing any software of firmware, discuss and confirm with the City the version of software or firmware to be installed and standardized on.

.4 Prior to commissioning, upgrade all software to the latest stable release version.

.5 The workstation shall have drivers for printing PDFs.

.6 Provide software licenses including, but not limited to the following:

.1 Windows 10 LTSC Enterprise Licence for Operator Workstations (Quantity: 1).

.2 Aveva Plant SCADA desktop client license (Quantity: 1).

.3 Aveva Plant SCADA Connector (Quantity: As Required).

.4 Aveva Historian Client License (Quantity: 1).

.5 Provide additional licenses as required for implementation (ex. OPC licenses).

.6 Maintain licenses for programming and configuring all project equipment throughout the entire project duration (example: EcoStruxure Control Expert eXtra Large – formerly Unity Pro).

2.2 Operator Workstation Hardware

.1 Operator workstations are to be fan-less machines with suitable passive cooling.

.2 Processor:

.1 Minimum: 2.4 GHz.

.2 Minimum: 4 Core.

.3 RAM:

.1 Minimum: 8 GB DDR4.

.4 Storage:

.1 128GB Solid State Drive.

.5 Video Output:

.1 Port 1: HDMI v1.3, 1920x1080 60Hz.

.6 Network Ports:

.1 1 Gb/s Ethernet ports.

.2 Connect to the Supervisory Network.

.7 USB Ports:

.1 Minimum: 4 ports at USB 3 10 Gb/s.

.8 Audio Port:

.1 HDMI and 3.5mm TRRS audio jack.

.9 Power Supply:

.1 Voltage: 120 Vac.

.2 Rating: Minimum 80 Plus Gold.

.10 Operating System:

.1 Windows 10 LTSC.

.11 Monitor:

.1 Type: LED –backlit LCD.

.2 Size: 32” diagonal.

.3 Aspect Ratio: Widescreen.

.4 Resolution: 1920 X 1080 @60HZ.

.5 Video Interface: VGA/HDMI/DP.

.12 Mouse:

.1 Two (2) buttons with mouse wheel,

.2 Sensor: laser or optical,

.3 Colour: Black,

.4 Connection: Corded, USB, and

.5 Mousepad: fabric covered foam pad

.13 Keyboard:

.1 Layout: Commercial Grade, US-layout, integral number keypad.

.2 Colour: Black.

.3 Connected: Corded, USB.

.14 Cables:

.1 As Required.

.15 Desk:

.1 Provide a desk for the operator workstation. A table re-purposed for use as a desk shall not be acceptable.

.2 Desk shall allow sufficient space for monitor, keyboard, mouse and mousepad, chair, and other accessories as required.

.3 Minimum two (2) Drawers per desk.

.4 Minimum Load rating: 300 lbs.

.16 Chair:

.1 Provide office chair with leather style finish.

.2 Minimum 5 wheel castor chairs, swivel base.

.3 Adjustable height, recline, and arm rests.

.4 Integrated head rest.

.5 Black or brown color.

2.3 Operator Workstation Software

.1 License and Install McAfee End Point Security on the PCS Workstation:

.1 Configure McAfee according to Plant SCADA vendor recommendations for compatibility.

.2 The City to provide the local repository for updating the EPS. Schedule automatic updates to be performed weekly for each workstation. Set up the updates to occur on Wednesdays at 12:00 PM.

3. EXECUTION

3.1 Domain Controller

.1 The City has existing Domain Controllers, join the existing domains.

.2 At a minimum the following shall be completed prior to requesting to join the City's existing domain.

.1 Install the operating system.

.2 Configure the correct time zone.

.3 Configure the network.

.4 Enable Remote Desktop.

.5 Set Remote Registry service start-up type to Automatic.

.6 Disable Windows Update Service.

.3 Domain Controllers' Windows Time service shall have Startup Type "Automatic". Use the W32tm.exe tool to configure Windows Time service (W32time) "manualpeerlist" provided by the City.

.4 Windows Time service shall have Startup Type "Automatic". The time source will be one of the domain controllers by default and no specific time source needs to be specified.

3.2 User Accounts

.1 The HLAP defines the existing preconfigured user groups from the City's existing Domain Controller, accounts of each level will be provided for the Integrator to complete testing and commissioning. Consult with the City if additional domain user groups and/or accounts are required to meet the functionality of the PCS.

.2 The Contractor will have local administrator privileges (except the Domain Controller) to hardware under the Contractor's ownership.

.3 Local user groups should be limited to the groups automatically created by required software packages in the domain environment. Consult with the City if additional local user groups and/or accounts are required to meet the functionality of the PCS.

.1 Use the local administrator to install software for each machine.

.4 Domain/Administrators group shall be included as members of the highest privilege local groups that are required for each software package.

.5 Domain/Administrators group shall have all privilege levels on the running Plant SCADA project.

.6 Domain/Administrators group shall have Server Role of public and sysadmin for SQL Servers.

.7 The City will retain an account with administrator rights at all times for all hardware. These accounts will only be used as required on hardware under ownership of the integrator to maintain the treatment capacity and functionality of the plant.

.8 EI Group:

.1 Users in the EI Group shall have view only access to all process equipment and alarms. The EI Group shall be able to remotely operate and acknowledge alarms for electrical equipment.

.2 No other user groups shall be able to remotely operate electrical equipment.

3.3 Development Server

.1 Upon request the City will deploy one development “sandbox” Virtual Machine (VM) on the City’s existing servers for the project. This development VM may be used for testing and development of the PCS functionality for the project as required.

.2 Final testing, commissioning, and the observation period will not use the development VM. All performance will be tested on the operational servers.

3.4 Server Integration

.1 Integrate the new work with the PCS SCADA and Historian servers.

.2 The EcoStruxure Control Expert files for the Primary Clarifiers area will be provided upon request for review or active development of the PCS for the work.

.1 When requesting the files for active development, a plan must be submitted to the Contract Administrator for review with clear details on what work will be performed and what schedule will be followed.

.2 As NEWPCC is an operational plant, requests may be denied and asked to be revised if the requested duration of the development appears to be excessive for the scope of work being programmed. This is to ensure the plant maintenance staff have appropriate access to modify the plant controls as needed.

.3 Data recording and retention on the Historian Server shall be set up as per the City’s Historical Data Retention Standard.

3.5 Workstation Installation

.1 Install Operator Workstations in control rooms as shown on the drawings.

.2 Install computer, monitor, mouse, mouse pad, and keyboard on the operator desk within the control room.

.3 Provide and connect network cabling as required.

.4 Organize all cabling in a neat and tidy fashion. Utilize tie-wraps to group and organize cabling.

.5 Upon installation of HMI and Historian clients, fully test all client application functionality. Correct all deficiencies to enable all manufacturer's functionalities.

.1 HMI clients should be set to automatically connect to the Primary HMI Server and automatically fail to the Secondary HMI Server if the Primary Server is not available.

.2 The HMI clients will have a manual mode to manually set which HMI Server they will connect to.

.3 Historian clients should be set to automatically connect to the Tier 1 Historian Server and automatically fail to the Tier 2 Historian Server if the Tier 1 Server is not available.

.4 The Historian clients will have a manual mode to manually set which Historian Server the will connect to.

.6 Disable local operating system firewalls.

.7 Configure Windows to auto login on boot up with a predefined Windows account.

.8 Plant SCADA client should automatically start with a view only user account.

.1 Upon a user logging out the predefined view only account will automatically login.

.9 Configure Print to PDF as the default printer for the autologin windows user account.

.10 Request and map City Drives to a network folder determined by the City.

.1 Configure the drives to reconnect at sign-in for Operators.

.11 Install BGInfo and set to Auto Start on user login.

.1 A sample configuration of BGInfo currently used by the City will be provided for minimum requirement.

3.6 Contract Closeout

.1 Provide in accordance with Section 01 78 00.

END OF SECTION

NETWORK EQUIPMENT

1. GENERAL

1.1 Description

.1 Install and configure the extension of the control and supervisory network, please see the Automation Design Guide for further explanation of the different network functionality.

.2 Supply, install, and commission two new fibre cables from the existing Area P Control Room to the Primary Scum Dewatering Building Network Panel.

.3 Supply, install, and commission the new Network Panel as shown on the drawing including all network equipment within the Scum Dewatering Building as shown on the drawings.

.4 Supply, install, and commission 5 new Profibus Networks as shown on the drawings.

.5 All work provided on the network shall adhere to the requirements of the Automation Design Guide.

1.2 References

.1 Comply with latest edition of the codes and standards applicable and/or referenced in Section 40 90 00.

1.3 Submittals

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

.2 Submit updated network architecture drawings with tags and device configurations.

2. PRODUCTS

2.1 Ethernet Cables

.1 Provide for network connections as specified in Section 26 05 20.

2.2 Ethernet Patch Cables

.1 Requirements:

.1 Cat-6, shielded.

.2 Jacket Colour: Blue.

2.3 Ethernet Switch – Control and Supervisory Networks

.1 Requirements:

.1 Input voltage: 24 VDC, redundant dual inputs.

.2 Ethernet Ports:

.1 10/100/1000 BaseT(X), quantity as indicated on the drawings.

.2 100/1000 BaseSFP, quantity as indicated on the drawings.

.3 SFP modules:

.1 1000Base (1 Gigabit) SX, LC Connector, 0.5 km, minimum of four per switch, or as indicated on the drawings.

.4 Console port: USB.

.5 Supported industrial protocols:

.1 PROFINET.

.2 EtherNet/IP.

.6 Management Protocols:

.1 RMON.

.2 RARP.

.3 DHCP Server/Client.

.4 DHCP Option 66/67/82.

.5 BootP.

.6 Syslog.

.7 LLDP.

.7 Security Protocols:

.1 HTTP.

.2 HTTPS.

.3 Telnet.

.4 SSH.

.8 Additional required supported protocols:

.1 IGMPv1/v2/v3.

.2 GMRP.

.3 GVRP.

.4 TFTP.

.5 SNTP.

.6 SMTP.

.7 SNMP Inform.

.8 SNMPv1/v2c/v3.

.9 IEEE 1588 PTPv2.

.10 IPv6.

.11 NTP Server/Client.

.9 Broadcast storm protection.

.10 Support for Port Trunking.

.11 Fanless design.

.12 DIN rail mount.

.13 Alarm relay dry contact: 1 A @ 24 VDC.

.14 IEEE 802.3x for Flow Control.

.15 Configuration via Web Browser.

.16 Operating temperature range: -10 to 60°C.

.17 Ambient Relative Humidity range: 5 to 95% (non-condensing).

.18 Enclosure: metal, IP30 protection.

.2 Manufacturer and Model:

.1 Moxa EDS-G512E-4GSFP with a minimum of four SFP-1GSXLC modules per switch.

.2 Moxa EDS-G516E-4GSFP with a minimum of four SFP-1GSXLC modules per switch.

.3 Or approved equal in accordance with B7.

.3 The use of Virtual Local Area Networks (VLANs) is not permitted.

2.4 Profibus Remote Master (Profibus DP/Modbus TCP Gateway)

.1 Requirements:

.1 This product was standardized by the City via RFP 756-2013.

.2 All requests for purchase or quotation shall reference RFP 756-2013 to receive standardized pricing that the City has negotiated with the vendor.

.3 Operating temperature range: 0 to 60°C.

.2 Manufacturer and Model:

.1 Schneider Electric Profibus Remote Master (PRM) TCSEGPA23F14F.

.2 No alternates or substitutes will be accepted.

2.5 Profibus Head Station Backplane

.1 Requirements:

.1 The Fixed backplane HS + 2 Sub fits 1 Head Station and 2 modules of any type and is extendible with standard backplane units on the right side.

.2 Manufacturer and Model:

.1 Procentec COMbricks 101-200023.

.2 Or approved equal in accordance with B7.

2.6 Profibus Repeater Head Station

.1 Requirements:

.1 Headstation for permanent PROFIBUS monitoring.

.2 No bus address required.

.3 Can monitor one PROFIBUS network.

.4 Power supply: 10.8 to 26.4 Vdc, max 800 mA.

.5 Ports: Ethernet 10/100 Mbps, RJ45 connector.

.6 Supported protocols: HTTP, FTP, SMTP, TELNET, DHCP, SNMP.

.7 Internal Web Server.

.8 Compatible Backplane Units, 101-200023, 101-200012.

.9 Approvals: CSA or equivalent.

.2 Manufacturer and model:

.1 Procentec COMbricks 101-20011B.

.2 Or approved equal in accordance with B7.

2.7 Profibus Repeater Power Supply Module

.1 Requirements:

.1 Power module provides additional power to the backplane when Head Station cannot power all inserted modules.

.2 Power supply: 12- 30 VDC, 2 Amps max.

.3 Provides 6A to backplane.

.4 Approvals: CSA or equivalent.

.2 Manufacturer and model:

.1 Procentec Combricks 101-230010.

.2 Or approved equal in accordance with B7.

2.8 Profibus DP Repeater, 2 Channel

.1 Requirements:

.1 Supported protocols: DP-V0, DP-V1, DP-V2, FDL, MPI, FMS, PROFIsafe and any other FDL based protocol.

.2 No bus address required.

.3 Transmission speed: Max 12 Mbps.

.4 Transmission speed auto detection.

.5 Integrated termination facility.

.6 Maximum 31 devices per channel.

.7 Screw terminations and DB9 connector for each channel.

.8 Operating temperature range: 0 to 60°C.

.9 Approvals: CSA or equivalent.

.2 Manufacturer and Model:

.1 Procentec Combricks 101-201102

.2 Or approved equal in accordance with B7.

2.9 Profibus DP/PA Link Module

.1 Requirements:

.1 Supported protocols: DP-V0, DP-V1, DP-V2, FDL, MPI, FMS, PROFIsafe and any other FDL based protocol.

.2 No bus address required on DP (Link has address 1 on PA).

.3 Fully transparent.

.4 PA transmission speed: 31.25 kbps.

.5 DP transmission speed: 9.6 kbps to 12 Mbps (including 45.45 kbps).

.6 Maximum 32 devices.

.7 Trunk voltage: 10 to 27 VDC (customizable and Non-Ex).

.8 Trunk current: 500 mA.

.9 Current consumption: 10 mA.

.10 Screw terminals for each channel.

.11 PA termination: Automatic.

.12 Operating temperature range: 0 to 60°C.

.13 Approvals: CSA or equivalent.

.2 Manufacturer and model:

.1 Procentec Combricks 101-201610.

.2 Or approved equal in accordance with B7.

2.10 Profibus PA Segment Protector

.1 Requirements:

.1 Connects several Field Devices to the network Trunk cable and provides short circuit protection.

.2 Short Circuit Protection.

.3 Mounting: DIN Rail.

.4 Degree Of Protection: IP20.

.5 Operating Temperature: -50 to +70°C.

.6 Minimum Input Voltage: 10 V.

.7 Voltage drop main cable/outputs: 1.3 V.

.8 Spur Device Current: 43 mA maximum (one device per spur).

.9 Spur Short Circuit Current: 58 mA maximum.

.10 Terminating resistor: removable external type 100 Ω +/- 10%.

.11 No. Of Ports: 6 and 12.

.12 Approvals: CSA or equivalent.

.2 Manufacturer and Model:

.1 PEPPERL+FUCHS, R2-SP-IC6, R2-SP-IC12, with M-FT terminating resistor.

.2 Or approved equal in accordance with B7.

2.11 Profibus DP Protector Module

.1 Requirements:

.1 This module protects Profibus/DP network against lightning strikes and surges.

.2 Max. Continues operating DC Voltage: 6.0 V.

.3 Nominal Current: 1 A.

.4 Operating Temperature: -40 to +80°C.

.5 CSA approved.

.6 Mounting: DIN Rail.

.7 Approvals: CSA or equivalent.

.2 Manufacturer and Model:.

.1 DEHN, BXT ML4 BD HF 5 Module, part number: 920 371

.2 DEHN, BXT BAS Protection Module Base, part number: 920 300.

.3 Or approved equal in accordance with B7.

2.12 Profibus PA Protector Module

.1 Requirements:

.1 This module protects Profibus PA network against lightning strikes and surges.

.2 Max. Continues Operating DC Voltage: 33 V.

.3 Nominal Current: 1A.

.4 Operating Temperature: -40 to +80°C.

.5 CSA Approved.

.2 Manufacturer and Model:

.1 DEHN, BXT ML4 BD 24 Module, part number: 920 344.

.2 DEHN,BXT BAS Protection Module Base, part number: 920 300.

.3 Or approved equal in accordance with B7.

2.13 Lightning Protection Module Test Device

.1 Requirements:

.1 Portable device for testing of BXT ML Lightning Protection Modules/

.2 Voltage Supply: Lithium Battery/

.3 RFID Transmission Frequency: 125 kHz.

.4 Operating Temperature: -20 to +60°C.

.2 Manufacturer and Model:

.1 DEHN, DRC LC M1+, part number: 910 655.

.2 Or approved equal in accordance with B7.

2.14 Copper Ethernet Modular Patch Panel

.1 Requirements:

.1 Mounting: 35 mm DIN Rail mount, TS-35 “U” Rail.

.2 2 X Single Copper Module.

.3 Shielded Keystone RJ45 Cat 6 Connectors.

.4 Ports: As noted.

.5 Rated for Shielded Cat 6 wiring.

.2 Manufacturer and model:

.1 Belden MIPP-BD-CSD4 (as required).

.2 Or approved equal in accordance with B7.

2.15 Spare Components

.1 Provide the following spare components:

.1 One (1) PROFIBUS repeater headstation.

.2 One (1) PROFIBUS power supply module.

.3 Two (2) PROFIBUS two channel repeater modules.

.4 Two (2) PROFIBUS DP/PA link modules.

.5 One (1) PROFIBUS Fiber Optic Module.

.6 One (1) PROFIBUS Remote Master.

.7 One (1) 6 channel PROFIBUS PA segment protector.

.8 One (1) 12 channel PROFIBUS PA segment protector.

.9 Ten (10) PROFIBUS DP protector modules.

.10 One (1) PROFIBUS PA protector module.

.11 One (1) Ethernet protector module.

.12 One (1) MODBUS serial to TCP gateway.

3. EXECUTION

3.1 Network Configuration

.1 City of Winnipeg staff will determine IP address allocation and provide to the Contractor upon request.

.2 Network speed of 1Gb/s throughout the plant is required.

.3 Provide hardwired fault monitoring wired back to the local area PCS PLC for all network switches.

.4 Refer to the City's Automation Design Guide for an overview of each network.

3.2 Profibus Network Installation and Commissioning

.1 See Section 40 90 21, Automation Wire and Cables for Profibus Cable installation guidelines.

.2 Install network terminations as indicated on the drawings.

.3 Verify operation of all network and devices on all Profibus network segments.

.4 Provide bus analysis and waveform capture of all Profibus network segments and verify that there are no errors. The PROFIBUS installation will not be considered complete if it has communication errors even if communication is occurring.

.5 See Commissioning Procedure documents for Profibus network commissioning details.

3.3 General Installation

.1 Configure process control network equipment so as to create a correctly communicating installation.

.2 Ethernet installations shall be certified to Category 6 standards.

.3 Equipment shall be installed in panels by a CSA certified panel shop.

3.4 Time Synchronization

.1 Enable time synchronization using SNTP:

.1 Use 2048 as a default time interval unless a shorter time interval is required for switch specific functionality.

.2 Use the default gateway.

3.5 Testing

.1 Refer to Section 40 99 91 and Section 40 99 93 for FAT, SIFT, SAT and SIT procedures.

.2 Demonstrate communication on all networks with live data from installed equipment.

.3 Perform ping tests at variable packet sizes to demonstrate that the network speed and bandwidth meet the manufacturer's specifications.

.4 Perform, monitor, and record live disconnections of network links to demonstrate the network recovery performance per the communication protocol and manufacturer's specifications.

.5 The installation will not be considered complete if there are errors even if communication is occurring.

.6 Use latest IEEE 802 standards for testing.

END OF SECTION

1. GENERAL

1.1 References

.1 Comply with latest edition of the codes and standards applicable and/or referenced Section 26 05 00.

.2 The following is a list of standards that may be applicable in this Section:

.1 National Electrical Code (NEC) OFCR-LS; Sunlight Resistant (SUN RES).

.2 Institute of Electrical & Electronic Engineers, Inc.IEEE-383/IEEE-1202 flame test suitable for direct burial.

.3 Telecommunications Industry Association (TIA); Electronics Industry Association (EIA):

.1 568, Commercial Building Telecommunications Cabling Standard.

.2 569-D, Telecommunications Pathways and Spaces.

.3 607-C, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.

.4 Canadian Standard Association (CSA):

.1 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations, most current adopted edition.

.2 CSA C22.2 No.2556, Wire and cable test methods.

.3 CSA C22.2 No. 230, Tray cables.

.4 CSA C22.2 No. 232, Optical fiber cables.

.5 CSA C22.2 No 262, Optical fiber cable and communication cable raceway systems.

.5 American National Standard (ANSI/NETA).

.1 ANSI/NETA ATS, Standard For Acceptance Testing Specification for Electrical Power Equipment and Systems.

.6 Manitoba Hydro:

.1 Manitoba Electrical Code, most current adopted revision.

.2 Manitoba Hydro Inspection Notices.

.7 City of Winnipeg:

.1 Automation Design Guide.

.2 Electrical Design Guide.

.3 Winnipeg Electrical By-Law.

.4 Information Bulletins.

1.2 Abbreviations

.1	dB	decibel
.2	EIA	Electronic Industries Association
.3	m	meter
.4	MHz	megahertz
.5	µ, micro	x 10^{-6}
.6	n, nano	x 10^{-9}

1.3 System Description

.1 This section covers requirements for the Fibre Optic Network.

.2 Function of Fibre Optic Network is to transmit digital data between network nodes.

.3 Provide a Fibre Optic Network based on referenced standards for use in the site automation networks.

1.4 Submittals

.1 Action Submittals: Shop Drawings:

.1 Subsystem detail design documents:

.1 Bill of Materials for Fibre Optic Network Components: Component number, manufacturer, model number, component description, and quantity.

.2 Cable schedule showing:

.1 Cable identification.

.2 Fibre counts for each cable and identification of used fibre pairs.

.3 Cable length and attenuation and planned number of splices. Splices, if any, shall be minimized. Splices require Contract Administrator approval.

.3 Component Data:

.1 Manufacturer and model number.

.2 General data and description.

.3 Engineering specifications and data sheet.

.4 Scaled drawings and mounting arrangements.

.5 Power and grounding requirements.

.6 Electrical and optic interfaces.

.2 Informational Submittals:

.1 Manufacturer's statement that installer is certified to perform installation Work.

.2 Contractor Qualifications:

.1 Fibre Optic Network Contractor: Minimum of five (5) years' experience providing, integrating, installing, and commissioning of similar systems.

.2 Fibre Optic Network Subcontractor's Site Representative: Minimum of five (5) years' experience installing similar systems.

.3 Acceptance of Fibre Optic Network Subcontractor does not exempt Subcontractor or Contractor from meeting Contract requirements, nor does it give prior acceptance of subsystems, equipment, materials, or services.

.3 Manufacturer's Certificate of Compliance, in accordance with Section 01 45 00, Quality Assurance.

.4 Manufacturer's suggested installation practice.

.5 Testing related submittals.

.6 Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data including the following:

.1 Updated versions of Hardware Shop Drawings Submittals.

.2 Component Manufacturers' O&M Manuals: Instructions for installation, operation, maintenance, and troubleshooting.

.3 List of spare parts provided.

.4 List of recommended additional spare parts.

.3 Factory Test Reports:

.1 Copy of Ethernet cable installer's factory certified installation certificate. Certificate shall have the name of the person who completed the training course and that person shall supervise all cable installation and termination for compliance with manufacturer recommendations.

.2 Copy of fibre optic cable installer's factory certified installation certificate. Certificate shall have the name of the person who completed training course and that person shall

supervise all cable installations and terminations for compliance with manufacturer recommendations.

.4 Installer Credentials:

.1 Submit the fibre installer's Corning Certificate.

1.5 Environmental Requirements

.1 Optical Fibre Cable and Cable Splice Centers:

.1 Outside, Underground/Submerged: -20 to 40°C.

.2 Outside, Overhead: -40 to 80°C.

.3 Outside, Aboveground in Conduit: -40 to 75°C.

.4 Inside: 0 to 40°C.

.2 Equipment:

.1 Outside, Aboveground: -40 to 75°C.

.2 Control Rooms, Equipment Rooms and Telecommunications Closets: 30 to 55% relative humidity, 18 to 24°C.

.3 Other Interior Areas: 0 to 100% relative humidity, 5 to 35°C.

2. PRODUCTS

2.1 Fibre Optic Cable

.1 Fibre Requirements:

.1 Multimode.

.2 Comply with the standards on References section.

.3 Fibre Core Diameter: 50 µm.

.4 Fibre Category: OM3.

.5 Wavelengths: 850 nm / 1300 nm.

.6 Maximum Attenuation: 3.0 dB/km / 1.0 dB/km.

.2 Cable Requirements:

.1 Type: Loose Tube, double jacket, chemical resistant, non-conductive.

.2 Application: Aerial, Direct Buried, Duct, Tray Rated.

.3 Flame Rating: LSZH (OFN-LS).

.4 Product Type: Dielectric.

.5 Temperature Range(operation): -50 to +75°C.

.6 Fibre Count: 24.

.7 Fibres per Tube: 12.

.8 Tape: Water-swellable.

.9 Inner Jacket: FRNC/LSZH Material.

.10 Tensile Strength Elements: Dielectric strength members.

.11 Outer Jacket: FRNC/LSZH Material.

.12 Max. Tensile Strength, Short-Term: 4500 N.

.13 Max. Tensile Strength, Long-Term: 1500 N.

.14 Compressive Loading: 2400 N/cm.

.15 Impact Resistance: 11.8 N*m.

.16 Min. Bend Radius Installation: 264 mm.

.17 Min. Bend Radius Operation: 176 mm.

.18 Nominal Outer Diameter: 17.6 mm.

.19 Chemical Resistance: RoHS.

.20 Approvals: CSA FT-4-ST1.

.3 Manufacturer and Model:

.1 Corning 036TUL-T3680D2M.

.2 Or approved equal in accordance with B7.

2.2 Fibre Optic Panel

.1 Enclosure:

.1 Corrosive Location:

.1 Single Door, Single Access Panel:

.1 Free Standing, NEMA 4X.

.2 Additional Security Doors:

.1 TS 35 DIN Rail Mountable, 445 mm x 483 mm (17.5” x 19”).

.2 TS 35 DIN Rail Mountable, 711 mm x 483 mm (30” x 19”).

.3 Frame:

.1 Tapped Hole, 44RU Main Frame.

.2 100 mm (4”) Frame Reducing Brackets.

.3 Additional 2000 mm (79”), Taped Hole, 44RU Rack Rail Pair.

.4 Door Mounted Folding Laptop Shelf.

.5 Dimension: 2000 mm x 800 mm x 800 mm (79” x 31” x 31”).

.2 Ordinary Location:

.1 Partial Door, Single Access Panel:

.1 Free Standing, NEMA 12.

.2 Partial Doors on Front Only:

.1 Lockable, 1500 mm x 600 mm (59” x 24”).

.2 Lockable, 500 mm x 600 mm (20” x 24”).

.3 Tapped Hole, 44RU Frame.

.4 Door Mounted Folding Laptop Shelf.

.5 Dimension: 2000 mm x 600 mm x 800 mm (79” x 24” x 31”).

.2 Partial Door, Dual Access Panel:

.1 Free Standing, NEMA 12.

.2 Partial Doors on Front and Rear:

.1 Lockable, 1500 mm x 600 mm (59” x 24”).

.2 Lockable, 500 mm x 600 mm (20” x 24”)

.3 Tapped Hole, 44RU Frame.

.4 Door Mounted Folding Laptop Shelf.

.5 Dimension: 2000 mm x 600 mm x 800 mm (79” x 24” x 31”).

.3 Single Door, Swingout Panel:

.1 Wall Mount, NEMA 12.

.2 Single door, lockable, double hinged.

.3 Tapped Hole, 12RU Frame.

.4 Dimension: 635 mm x 600 mm x 550 mm (25” x 24” x 22”).

.2 DIN Rail Mount Kit:

.1 TS 35 mm (1.4”), slotted.

.2 Depth adjustable, 2RU, 483 mm (19”) Rack Mount.

.3 When used to mount terminals, rails shall be mounted on straight raisers (rail support / mounting feet) so as to raise them so that the top of the terminals are at the same height as the top of the adjacent wiring duct.

.4 Raisers (rail support / mounting feet) shall not be used when rail hosts heavy components.

.3 Terminals:

.1 Quantity:

.1 Accommodate present and spare indicated needs.

.2 One wire per terminal for field wires entering/exiting enclosures.

.3 Maximum of 2 wires on each side of a terminal for internal enclosure wiring.

.4 Installed Spare Terminals: As shown on the drawings.

.2 General:

.1 Connection Type: Screw compression clamp.

.2 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.

.3 Screws: Hardened steel, captive, and self-locking.

.4 Current Bar: Copper or treated brass.

.5 Insulation:

.1 Thermoplastic rated for -55 to 110°C.

.2 Two funneled shaped inputs to facilitate wire entry.

.6 Mounting:

.1 Standard DIN rail.

.2 Terminal block can be extracted from an assembly without displacing adjacent blocks.

.3 End Stops: Minimum of one at each end of rail.

.7 Jumpers: Allow jumper installation without loss of space on terminal or rail.

.8 Marking System:

.1 Terminal number shown on both sides of terminal block.

.2 Markings must be machine printed. Handwritten markings are not allowed.

.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.

.9 Terminal blocks shall be designed for the size of the wires to be connected to them. Terminal blocks used for analog, digital, and power cables shall be identified and physically separated from each other.

.10 Drawings and templates supplied may not detail all hardware components such as labels, stoppers, rail lifters, end plates, separators, etc. The supplier must supply and install such components when required.

.11 Loose Spare Requirements:

.1 Provide either thirty (30) or three (3) percent, whichever is less, of each type of terminal used on the Project.

.3 Terminal Block Types:

.1 Control wiring

.1 General:

.1 Connection type: Screw connection.

.2 Mounting: TS 35 mm DIN rail.

.3 Approval: CSA.

.2 Manufacturer and Series:

.1 Weidmuller W-series.

.2 Or approved equal.

.3 Standard of Acceptance:

.1 Terminal Block, Feed-through:

.1 Rated Voltage: 800V AC.

.2 Rated Current: 32 A.

.3 Wire Size: 26 to 10 AWG.

.4 Colour: Dark Beige Body.

.5 Width: 6.1 mm.

.6 Standard of acceptance: Weidmuller WDU 4.

.2 Terminal Block, Ground:

.1 Wire Size: 26 to 10 AWG.

.2 Colour: Green and yellow body.

.3 Width: 6.1 mm.

.4 Grounding: Electrically grounded to mounting rail.

.5 Standard of acceptance: Weidmuller WPE 4.

.3 Terminal Block, Knife Disconnect:

.1 Rated Voltage: 300V AC.

.2 Rated Current: 10 A.

.3 Wire Size: 22 to 10 AWG.

.4 Colour: Dark Beige body, orange switch.

.5 Width: 6.1 mm.

.6 Standard of acceptance: Weidmuller WTR 4.

.4 Terminal Block, Fused:

.1 Rated Voltage: 300 VAC.

.2 Rated Current: 10 A.

.3 Wire Size: 22 to 10 AWG.

.4 Colour: Black body.

.5 Width: 6.1 mm.

.6 Fuse: 5 mm x 20 mm.

.7 Standard of acceptance: Weidmuller WFS 4.

.5 Terminal Block, Double Level, Fused:

.1 Rated Voltage: 300 VAC.

.2 Rated Current: 10 A.

.3 Wire Size: 26 to 12 AWG.

.4 Color: Dark Beige Body.

.5 Width: 8 mm.

.6 Fuse: 5 mm x 20 mm.

.7 Standard of acceptance: Weidmuller KDKS 1/35 DB.

.2 Power wiring over 6.3 A

.1 General:

.1 Connection type: Screw connection.

.2 Mounting: TS 35 mm DIN rail.

.3 Approval: CSA.

.2 Manufacturer and Series:

.1 Weidmuller W-series.

.2 Or approved equal.

.3 Standard of Acceptance:

.1 Terminal Block, Feed-through:

.1 Rated Voltage: 600 VAC.

.2 Rated Current: 85 A.

.3 Wire Size: 18 to 6 AWG.

.4 Colour: Dark Beige body.

.5 Width: 11.9 mm.

.6 Standard of acceptance: Weidmuller WDU 16.

.2 Terminal Block, Fused:

.1 Rated Voltage: 150 VAC.

.2 Rated Current: 16 A.

.3 Wire Size: 20 to 6 AWG.

.4 Color: Dark Beige body.

.5 Width: 11.9 mm.

.6 Fuse: 6.3 mm x 32 mm.

.7 Standard of acceptance: Weidmuller WSI 6/2 GZ/DEF63.

.4 Power Supply:

.1 Approvals: CSA.

.2 Watt Rating: 120 W.

.3 Input: 100-240 VAC, 45-65 Hz.

.4 Output: 24 VDC.

.5 Mounting: TS 35 DIN rail.

.6 Capable of parallel operation.

.7 Temperature derating: linear derating to half power from 60°C to 70°C

.8 Output ripple: < 50 mV peak-to-peak.

.9 Efficiency: 88% or greater.

.10 Status lights:

.1 DC OK LED: active, green.

.11 Status contacts:

.1 Power supply failure, qty 1 normally open (Form A), contact closed during normal operation.

.12 Environmental:

.1 Temperature, operating: -10 to 60°C.

.2 Humidity, operating: max 90%, non-condensing.

.13 Manufacturer and series:

.1 SolaHD SDN-P Series.

.2 Or approved equal.

.5 Uninterruptible Power Supply:

.1 Approvals: CSA.

.2 Watt Rating: 500 W.

.3 Input: 100-240 VAC, 45-65 Hz.

.4 Output: 120 VAC.

.5 Mounting: TS 35 DIN rail, shelf, or panel mount.

.6 Environmental:

.1 Temperature, operating: 0 to 60°C.

.2 Humidity, operating: max 90%, non-condensing.

.6 Overcurrent Protection:

.1 Panel-mounted devices and all control circuits shall be protected by appropriately sized fuses or circuit breakers.

.7 Duplex Receptacle:

.1 Approvals: CSA.

.2 Heavy duty specification grade, two-pole, three-wire grounding type with screw type wire terminals suitable for No. 10 AWG.

.3 High strength, thermoplastic base colour.

.4 Colour:

.1 Non-essential powered receptacles: White.

.2 UPS-powered receptacles: Orange.

.5 Contact Arrangement: contact to be made on two sides of each inserted blade without detent.

.6 Rating: 125 V, configuration 5-15R, 15 A.

.7 One-piece mounting strap with integral ground strap, rivetless construction.

.8 Mounting: TS 35 DIN Rail.

.9 Enclosure: Outlet box, 115 mm x 75 mm x 55 mm (4.5” x 3” x 2”), with faceplate.

.10 Receptacles shall be of one Manufacturer throughout the project.

.11 Manufacturers and products:

.1 Arrow Hart 5262 Series.

.2 Bryant 5262 Series.

.3 Hubbell 5262 Series.

.4 Or approved equal.

.8 Ethernet Switches and Patch Cables as specified in Section 40 95 53.

2.3 Fibre Optic Closet Connectors (CCH)

.1 Function: The CCH provides a rack-mount housing for fibre cassettes. The cassettes are complete with pre-terminated patch plates and pigtails. The CCH is installed inside plant Network Panels and Network Patch Panels.

.2 Splice Cassette:

.1 24 fibres.

.2 Pre-terminated patch plate with LC duplex connectors. Connectors to have zirconium ferrule inserts.

.3 OM3.

.4 Single Fibre Splicing.

.5 3 m pigtail.

.3 Rack-mount housing:

.1 General requirements:

.1 RoHS Compliant.

.2 Suitable for installation on standard 483 mm (19”) rack.

.2 48 Strand Maximum Housing:

.1 Capacity: up to 48 strands via 2 cassettes.

.2 Dimension: 44 mm x 482.6 mm x 434.34 mm (1.75” x 19” x 17”), 1RU.

.3 96 Strand Maximum Housing:

.1 Capacity: up to 96 strands via 4 cassettes.

.2 Dimension: 88.9 mm x 482.6 mm x 434.34 mm (3.5” x 19” x 17”), 2RU.

.4 144 Strand Maximum Housing:

.1 Capacity: up to 144 strands via 6 cassettes.

.2 Dimension: 133.35 mm x 482.6 mm x 434.34 mm (5.25” x 19” x 17”), 3RU.

.5 288 Strand Maximum Housing:

.1 Capacity: up to 288 strands via 12 cassettes.

.2 Dimension: 177.8 mm x 482.6 mm x 434.34 mm (7” x 19” x 17”), 4RU.

.4 Manufacturer and Models:

.1 Corning CCH-01U, CCH-02U, CCH-03U, CCH-04U, and

.2 Corning CCH-CS24-E4-P00TE, Splice Cassette.

.3 Or approved equal in accordance with B7.

2.4 Fusion Splice Protector

.1 Heat shrinkable splice protects the fusion splice on fibres securely.

.2 Requirements:

.1 Multifibre or single fibre Sleeve, 40 or 60 mm length.

.2 Fibre Diameter: 50 µm.

.3 Heating Time: 64 Sec. for single fibre sleeve and 80 sec. for multi fibre sleeve.

.3 Manufacturer and Model:

.1 Corning, 2806031-01.

.2 Or approved equal according to B7.

2.5 Patch Cables

.1 In accordance with requirements of EIT/EIA 568, section 12.5.

.2 Features:

.1 Low Loss.

.2 2 fibres, LC duplex to LC duplex.

.3 50 µm Multimode (OM3).

.4 Wavelengths: 850 nm / 1300 nm.

.5 Zip Cord Tight buffered cable.

.6 Riser, 2.0 mm legs.

.7 Insertion loss, typical: 0.1 dB.

.8 Insertion loss, max.: 0.15 dB.

.9 Outer jacket material: LSZH/FRNC.

.10 Length: as required to suit installations without strain.

.3 Manufacturer:

.1 Corning E050502T5120001M and E050502T5120003M for 1 and 3 m.

.2 Or approved equal in accordance with B7.

3. EXECUTION

3.1 Installation

.1 Coordinate network cable installation with contractor's and City's activities at site. Provide at least five (5) business days notice before requiring access to facility to work in existing Network Panels or installing new.

.2 Install all underground network cabling in conduit or duct as indicated. Size conduit for the number of cables contained and observe the cable manufacturers recommended bending radius.

.3 All network cabling within buildings to be installed in cable tray. Conduit runs are not permitted.

.4 Rod and swab out existing ducts prior to installing new cables. Inspect existing raceways and boxes for allowable bending radius prior to installing cable and notify the Contract Administrator of any condition which would prevent the proper installation of the cable.

.5 Install cable without splices between network components.

.6 Follow manufacturer's installation practices.

3.2 Conduit System

.1 Ensure that installed conduit system conforms with fibre optic system requirements, including:

.1 Conduit size and number.

.2 Access Holes and Pull Boxes: Location and size, to ensure cables can be installed without exceeding manufacturer's limitations.

.3 Outlet Boxes: Size to coordinate with outlet cover plates for adequate volume and bend radius.

.2 Expansion Plugs: Seal conduits to stop ingress of water and grit with fabricated expansion plugs.

3.3 Fibre Optic Cable

.1 Installation by Corning certified installer. Provide Corning certification as a shop drawing. Provide similar credentials for the manufacturer if alternative approved fibre is provided.

.2 Install cables in accordance with manufacturer's requirements.

.3 Install cable directly from shipping reels. Ensure that cable is not:

.1 Dented, nicked, or kinked.

.2 Subjected to pull stress greater, or bend radius less, than manufacturer's specification.

.3 Subjected to treatment that may damage fibre strands during installation.

.4 Cables Per Conduit: One cable maximum.

.5 If the link loss calculation indicates that the total cable system attenuation equals or exceeds the total link loss budget, rerouting may be allowed, if approved by Contract Administrator.

.6 Splices: Install fibre optic cables in unspliced lengths between fibre centers.

.7 Identification: Identify cable on both ends and in access holes and pull points it goes through. Identify with tags in accordance with Division 26. Use water proof tags.

.8 Sealing: Seal cables to stop ingress of water and grit with fabricated expansion plugs.

.9 Fibre cable shall be crossed over between patch panel terminations for each fibre strand pair, such that for duplex communication the patch cables at both ends will remain the same.

.10 Ground armoured cabling as close as practical to where the cables enter the building at one end only.

.11 Provide a 2 m coil for fibre cables terminating within cabinets. Coil neatly within the bottom of the cabinet.

3.4 Field Quality Control

.1 Test components of installation in accordance with standards and specifications.

.2 Provide equipment, instrumentation, supplies and skilled staff necessary to perform testing.

.3 Advise Contract Administrator at least forty-eight (48) hours in advance of each test. Contract Administrator shall have option to witness and participate actively in tests.

.4 Document test results of each cable to confirm that at least specified number of fibres meet standards. Submit all test reports to the Contract Administrator to document the results of all of the testing requirements as well as the sate and conditions of the tests.

.5 Document results of repeater and transceiver tests.

3.5 Tests and Inspection

.1 In accordance with Division 1.

.2 Conduit:

.1 Testing and Sealing of Spare Conduits.

.2 Conduit Testing:

.1 Blow full-diameter mouse through each spare conduit to verify they are unrestricted over full length.

.2 If any conduit is not unrestricted over full length, advise Contract Administrator.

.3 Documentation: Document and submit testing results to the Contract Administrator for review prior to installing cable.

.3 Cable Inspection:

.1 Compare cable, connector, and splice data with drawings and specifications.

.2 Inspect cable and connections for physical and mechanical damage.

.3 Clean fibre connectors with specialty formulated cleaning solution if required, Follow cleaning kit manufacturer’s instruction.

.4 Cable Testing:

.1 Field test all fibres for end to end attenuation of an installed link as per TIA-568-C.0 Test all spare fibres from patch panel to patch panel.

.2 The total link attenuation shall be less than its corresponding networking equipment loss budget.

.3 All tests shall be bi-directional.

.4 Perform cable length measurement, fibre fracture inspection and construction defect inspection using an Optical Time Domain Reflectometer (OTDR). The OTDR signal shall be analyzed for excessive connection, splice or cable backscatter by viewing the reflected power/distance graph.

.1 OTDR images shall be included in the test report.

.5 Perform connector and splice integrity test using an OTDR. The OTDR signal shall be analyzed for excessive connection, splice or cable backscatter by viewing the reflected power/distance graph.

.6 Perform cable attenuation loss measurement with an optical power loss test set. Attenuation loss, of each fibre, in dB/km shall be within manufacturer's recommendation.

.7 Perform connector and splice attenuation loss measurement from both ends of the optical cable with an optical power loss test set. Attenuation loss in shall be within manufacturer's recommendation.

.8 Until requirements are met, replace and retest all cables that do not have specified number of fibres that meet attenuation standards. The installation will not be considered complete until all requirements are met in all fibres even if communication is occurring.

.9 Submit a test report summary and all associated test data to the Contract Administrator at the completion of the testing.

END OF SECTION

APPLICATIONS SOFTWARE

1. GENERAL

1.1 Description

.1 Applications software is the software that provides functionality unique to this project, or that requires specific configuration from the standard software. All Applications software is to be developed or configured by the Contractor under this Contract.

.2 This Work includes:

.1 Developing, testing, debugging, troubleshooting, documenting, training, and system start up of a complete and comprehensive Process on the Process Control System (PCS) comprised of distributed area PLCs, RIOs, and Profibus networks working with HMI and Historian Servers and operator workstations on a dedicated layered network to provide robust and reliable control system to run NEWPCC operations.

.2 It is important for the Integrator to have a strong understanding of the Wastewater industry and the process in each area of the plant. Review of contract documents, plant materials and existing logic will be required to gain the comprehensive understanding required to develop the Process Control System behaviour.

.3 Set up, configure, and develop all programs, databases, environments for a fully operable system as described in the drawings, specifications, and appendices.

.4 Modify and tune the control loops and software interfaces to create a cohesive control system including:

.1 Proportional, Integral, and Derivative (PID) response parameters for control loops.

.2 Individual equipment performance.

.3 Data communication between processors, workstations, and servers.

.4 Operator workstation displays.

.5 Networking hardware configurations.

.6 PLC and HMI configurations.

.5 Provide temporary PLC programming as required during the testing and commissioning. Provide all updates to programming as required during the project to keep the NEWPCC plant functional for the operations staff to maintain the provincial license.

.3 The Contractor shall schedule the workshops specified in this section. Provide a minimum of three (3) weeks notice for a software design workshop.

.1 Integrate existing PLCs and vendor packages into the PCS.

.1 Provide all PLC programming on vendor, existing, and new PLCs to facilitate data exchange as required for the seamless integration of existing PLCs into the PCS.

All monitoring, controlling, and alarming of existing PLCs shall be accessible from any PCS workstation after the integration.

.2 Replicate any vendor HMI screens using the new graphics developed by this project, or as provided by the City, in the PCS.

.2 Configure all network settings and configurations for reliable communication between the provided devices and the existing plant. Where redundant paths are installed, provide configuration to allow for automatic fail-over to the redundant network paths.

.3 At anytime when equipment is controlled by the PCS, the Operators must have the means to control the equipment including automated control where required for control loops. Provide infrastructure and access to required setpoints, provide training to operators on use of PCS system.

.4 Refer to Appendix A for the associated City Standards. These City Standards are to be followed for all installations associated with this project.

.4 All application software and configuration developed or modified under this contract shall be owned by the City. The City may use this software for maintenance or development within NEWPCC or for other City Projects. The City may provide this application software to third parties to develop software on the City's behalf. All applicable intellectual property developed under this project shall be transferred to the City.

1.2 Software Design Workshops

.1 Location: Contractor's Trailer on site.

.2 Objective: To allow for oversight and review of the Applications Software development.

.3 The Contractor shall prepare and distribute an agenda prior to the workshop.

.4 The Contractor shall collaborate with the City in the workshop.

.5 The Contractor shall take minutes and distribute the minutes within two (2) days of the workshop.

.6 Workshops:

.1 Configuration Workshop:

.1 Occurrence: Once at beginning of project.

.2 Scope: Contractor shall review all Application Software that will be used in the project and how they will interface. The schedule for software development will be reviewed. Requirements for software development submittals will be discussed.

.2 Standardized Logic Block Workshop:

.1 Occurrence: As required to demonstrate and review all standardized logic blocks as specified in Section 40 94 43.

.2 Scope: Review and demonstrate the standardized logic blocks. Workshop can combine multiple standardized logic blocks together.

.3 Standardized HMI Graphic Workshop:

.1 Occurrence: As required to demonstrate and review all standardized HMI graphics.

.2 Scope: Review and demonstrate the standardized HMI graphics including HMI layouts, equipment graphics, HMI navigation, user interface elements and trending. Workshop can combine multiple standardized HMI graphics together.

.4 Pre-Programming Workshop:

.1 Occurrence:

.1 Once after review of the PCNs and Vendor logic but before significant development has started on the PCS development for the area.

.2 Once per PLC to be integrated. After review of the PCNs and PLC logic but before significant development has started on the PCS development for the PLC Integration.

.2 Scope: Review the process area requirements and gather input from the operations and maintenance staff. Go over major control loops and how the logic will be implemented in the PCS. Review network interface maps affecting the area.

.5 Commissioning Area Workshop:

.1 Occurrence:

.1 Once per migration stage at the end of the PCS development for the area.

.2 Once per PLC integration at the end of the PCS development for the area.

.2 Scope: Review the commissioning plans for the area and proposed sequencing of commissioning within the area and associated schedule. Review and demonstrate the developed logic. Review and demonstrate the developed HMI Screens. Review required communication between the new equipment and the existing PCS before, during, and after commissioning. Review Operator control requirements and process downtimes during switchover. Review and demonstrate all required HMI functionality including alarming and trending. Demonstrate all functionality as requested by the Contract Administrator and City.

1.3 Submittals

.1 Submit the following in accordance with Section 01 33 00:

.1 Provide with Section 01 32 16.07 Construction Schedules an updated schedule based on software development.

.1 Every two (2) weeks at the construction meeting while the software is under development, a lead developer that is familiar with the state of the software

development will attend and share their screen to review the progress made since the previous software review.

.1 Provide demonstrations of the software upon request.

.2 Provide software to Contract Administrator upon request.

.2 Shop Drawings:

.1 Outline of applications software to be developed.

.1 An overview description of each major software package and programming language or configuration method to be used for each different type of application.

.2 Schedule of each applications software.

.3 Standardized HMI Graphics:

.1 Submit documented copies of the standardized HMI graphics including screen layouts, HMI navigation, facility overview, active alarm page, historical events, trends, faceplates, process area and user interfaces.

.2 Documentation shall at a minimum include all details to understand the use of the graphic including:

.1 Description.

.2 Animation(s).

.3 Colour(s).

.4 HMI Faceplates:

.1 The faceplates shall be developed along side the standardized function blocks for seamless interfacing of the logic and faceplates.

.5 User Interactions.

.6 User Interaction Response.

.7 Trend Screens.

.8 Active Alarms.

.9 Historical Events.

.10 Headers and Footers.

.11 Dashboard.

.12 See the HMI Layout and Animation Plan in Appendix A for additional requirements.

.3 Demonstrate all HMI graphics.

.4 Software Design Submittal:

.1 Preliminary Design:

.1 Submit a HMI and PLC design criteria prior to initiating programming which includes:

.1 The general PLC function blocks derived from the PCN and existing (as applicable) PCS logic.

.2 The general PLC program structure.

.3 PLC memory map in broad categories (address ranges).

.4 The programming languages to be utilized.

.5 HMI Layout and animation criteria

.2 25% Design:

.1 Submit a 25% complete submittal for each area, including Software Logic and HMI screens in pdf and native format.

.2 Include updated interface maps in excel and pdf format meeting the criteria of the automation design guide.

.3 The primary purpose of this submittal is to ensure that the methodology being utilized is as per requirements prior to bulk portion of work being completed. At this point, copies of code for similar pieces of equipment should not be completed.

.4 A plan for all HMI screens in the area including a rough layout shall be included. With at least 3 unique and distinct screens at 99% level of design. The three screens at 99% level of design shall not be copied and pasted of each other, similar trains, or of previous areas of the plant.

.5 The 25% Design submittal shall be resubmitted for review after incorporating all comments.

.3 99% Design

.1 Submit a 99% complete submittal for each area a minimum of 20 working days prior to the FAT, including:

.1 Complete software logic and HMI screens in pdf and native format.

.2 PLC database and HMI interface data map in excel and pdf format.

.3 Third party interface list in excel and pdf format.

.4 FAT and SIFT procedure (see Section 40 99 91, FAT and SIFT Procedures for requirements).

1.4 Quality Assurance

.1 Provide in accordance with Section 01 45 00 and as specified.

1.5 Delivery, Storage and Handling

.1 Provide in accordance with Section 01 61 00 and as specified.

1.6 Warranty

.1 The Contractor shall warrant that all materials and equipment furnished under the Contract are in good working order, free from defects, and in conformance with system specifications. All installed equipment shall conform to the manufacturer's official published specifications. The warranty shall begin at the system acceptance date and remain in effect for a period of one years from that date. The Contractor shall agree to repair, adjust, and/or replace (as determined by the Contract Administrator to be in its best interest) any defective equipment, materials, or other parts of the system at the Contractor's sole cost. The City will incur no costs for service or replacement of parts during the warranty period of one (1) year. All third party warranties shall be passed through from the Contractor to the City.

.2 The Contractor shall warrant that all application software developed for the project shall be free from defects leading to unintended operation of the plant equipment. The application software will be based on the Process Control System requirements and the existing DCS functionality to replicate the existing control system. The warranty shall begin at the system acceptance date and remain in effect for a period of one years from that date. The Contractor shall agree to repair or adjust the application software if defects are found. The Contractor shall expedite the repair or adjustments to the level of severity to ensure no additional damages occur to the plant, personnel, or treatment capacity occur. All repairs or adjustments will not take longer than one (1) calendar month to complete from the time of notice.

.1 The system acceptance date is unique for each stage in the migration plan and covers the work developed in that stage.

.3 The Contractor shall warrant that the system will function in accordance with the manufacturer's published technical description guide.

.4 The City may make documented and tracked changes to add or modify logic based on operational requirements or self-correct any issues instead of making warranty claims. These adjustments to the program will not impact the warranty, and the new item to each program is not covered under the warranty.

2. PRODUCTS

2.1 PLC Software Development

.1 EcoStruxure Control Expert shall be used to develop all PLC software. The Contractor shall maintain their own license for software development throughout the project duration.

2.2 SCADA Set-up

.1 Plant SCADA Project:

.1 Cluster Name: NEWPCC.

.2 System wide parameters shall be defined in the Parameters section under Set-up.

.3 Parameters specific to a group of Servers or clients shall be defined in profile except where parameters are required to be defined in the local .ini file.

.4 Parameters specific to an individual machine shall be defined in local .ini.

.2 All alarms shall be recorded with the accurate synchronized time.

2.3 PLC Program Requirements

.1 The PLC system will provide all functionality including:

.1 Manual controls.

.2 Automatic controls.

.3 Alarm annunciation.

.4 Continuous control loops.

.5 Redundancy.

.2 Refer to the Automation Design Guide for PLC Programming Requirements.

.3 Additional requirements for PLC and PLC program in Section 40 94 43.

.4 PLCs shall be programmed with Function Blocks.

.5 All process control shall be implemented on the PLC.

.1 No HMI logic shall control the process.

.2 PLC function shall remain undisturbed if connection to the HMI lost.

.6 Format Function Block layouts into sheets the size of 11 x 17 inch paper for ease of printing. Group Function Blocks by logical control groups. Use landscape sheet orientation.

.7 Break PLC program into sections based on control loops or parallel process trains.

.8 Break PLC program sections into subsections based on individual equipment operation.

.9 Do not use indirect addressing and non-visible data links.

.10 All timer settings, set points, and miscellaneous adjustments will be determined during application software development or plant start up. All settings and adjustments shall be easily made through the programming software.

.11 Unless otherwise indicated, reset and start running all strategies following a power interruption. Software signal selectors and mode memories which are toggled or advanced by momentary signals, are required to retain their last setting through power outages, except as indicated otherwise.

.12 Logic outputs of function blocks shall only access Inputs and Outputs:

.1 Accessing function block's public variables are not allowed.

.13 All function blocks shall be connected by visible Link. Where this is unable to be achieved, this shall be thoroughly documented in a manner that it cannot be missed. This documentation shall be consistent throughout the project. Documentation of non-visible links to be approved by the Contract Administrator on a case by case basis.

.14 Limit cross over links to avoid clutter in the code. Simplify links as much as possible for ease of reading and maintenance.

.15 All Bool variables shall be named based on the variable when the value is 1 being true.

.16 Function Blocks shall be connected/placed in a way to minimize execution and propogation delay.

.17 Documentation:

.1 Overall process description, include relevant description on associated sheets.

.2 Hyperlinks to allow for clicking and following of signals.

.3 Physical hardware arrangement notes including equipment tags and IO cards in use.

.4 Signal names.

.5 Communication parameters and signals.

.6 Animation Table.

.7 Associated HMI screens.

2.4 HMI Software Requirements

.1 Existing HMI Server Software to tie into:

.1 I/O server.

.2 Report server.

.3 Alarm server.

.4 Trend Server.

.5 OPC Server.

.6 Modbus Driver.

.7 DNP3 Driver.

.8 Ethernet IP Driver.

.2 Manufacturer and Model:

.1 Aveva Plant SCADA.

.2 This product was standardized by the City via RFP 756-2013. No alternates or substitutes will be accepted. Provide licenses as required throughout the project duration.

.3 General:

.1 The Contractor shall develop the HMI design to allow for monitoring and control of the plant. HMI screens and layouts will be based on the existing P&ID drawings as a guide. Refer to the City's HMI Layout and Animation Plan for requirements and guidelines for PCS screen development.

.1 If there is a discrepancy between the P&IDs and the HMI Layout and Animation Plan, submit an RFI to the Contract Administrator for guidance, clearly show the discrepancy using visuals where needed.

.2 Provide navigation such that from the main screen:

.1 Any process area can be reached in one click of the mouse.

.2 Any control loop can be reached in two clicks of the mouse.

.3 Any individual device can be reached in three clicks of the mouse.

.3 Provide area to area navigation elements to allow for complete circular navigation through all process areas at the process area level.

.4 Maintain consistent graphics throughout the project.

.5 Maintain consistent layouts throughout the project.

.6 Layout the screens to best depict the actual process occurring while maintaining readability.

.7 Develop Event Journal for operator actions, the following will be included but not limited to journal log, user logon, time, change of process values, setpoints, and digital signals status change. The journal to log show current values to new values.

.8 Develop help screens and onscreen directions to provide additional information to help the operations staff understand the control options where complex operations are required.

.9 Where possible, design overview displays similar to the physical layout of the facility. The perspective to the physical layout should be from the local main control room.

.10 Provide operators access to all current setpoints available on the PCS. Limit set point ranges to reasonable limits for the process and as per vendors or manufacturer's equipment limits. Ensure setpoint permissions for Operators, the City's AICG, and the EI group are maintained.

.11 Display all monitored values. Graphic context shall update based on measured values.

.4 Loss of Communication Sensing by the control system:

.1 Monitor the health of each PLC at the plant including vendor supplied PLCs which are on the Control Network by directly monitoring the PLC systems' words. Display their various status parameters such as low battery, Primary/Secondary, Running/Not Running, and communications (normal/fail) conditions.

.2 Generate alarm if communication with the hot PLC fails or the hot PLC is not running for 60 seconds.

.5 PLC hardware alarms that are available from the PLC's system words shall be read by Plant SCADA directly from the PLC's system words without the use of intermediate PLC logic.

3. EXECUTION

3.1 Testing

.1 Refer to Section 40 99 91 and Section 40 99 92 for FAT, SIFT, SAT and SIT procedures.

3.2 Tuning

.1 Attain optimum system response and performance by tuning hardware and software components. Include the following:

.1 Poll block frequency and phasing.

.2 Point scan frequency.

.3 Trend scan frequency.

.4 Modbus RTU/TCP, LAN.

.5 Page change linkage.

.6 Plant Monitoring, Reporting and Data Logging.

.7 Regrouping of PLC points and files to optimize the quantity of blocks transmitted to process computers.

.8 Elimination of network transmission errors and time-out occurrences.

.2 Optimize PLC, PC, and network software to impose minimum loads on the equipment, with the following priorities:

.1 Minimal network traffic.

.2 PC processing.

.3 PLC processing.

.4 Network processing.

3.3 Reports

.1 The City may add and commission reports as Operations requires in areas handed over to the City.

.2 The City may directly connect to PLCs for data reporting requires in areas handed over to the City.

3.4 Vendor PLC Integration

.1 Integrate the vendor PLCs identified in the migration plan into the main PCS.

.2 Include all screens into the main PCS and add the available alarms, IO points, and navigation to create a seamless transition when interfacing with the vendor PLC equipment.

.3 Commission all functionality and interfaces of the vendor PLCs to show the functionality is maintained.

3.5 Software Copies

.1 Use and keep up to date version control application to save and track the program versions and the schedule of when each version is active in the plant. Provide the version control schedule and any historical application versions upon request of the Contract Administrator.

.2 Integrator to provide copies of all applications software to the Contract Administrator at beginning of switchover.

.1 Provides live copies daily to the Contract Administrator during the switchover for each day that the applications are modified.

3.6 Software Repairs

.1 When on-site commissioning and integration has begun, supply continuous services to effect start up, fine tuning, and removal of deficiencies in the software or data. Complete the integration and repairs within 1 month or less. If at the end of 1 month the software is not completely correct, then repair services may be provided by the Contract Administrator or an agent designated by the City and the actual cost incurred may be deducted from the Lump Sum Contract Price.

3.7 Training

.1 Film and record screens of at least one occurrence of each training type. Edit videos to show relevant information with overlays as required, remove any distracting contents. Edit videos to be concise. Submit training videos for review. Provide City with copies of each training video on USB.

.2 Training timing to be coordinated with the Contract Administrator.

.3 Management Seminar

.1 Occurrence: Once.

.2 Length: Two (2) hours.

.3 Location: NEWPCC.

.4 Objective: Walk through of new systems. Provide high level understanding of application software for monitoring and controls. Demonstrate how to generate custom reports and trends.

.4 Operations Training:

.1 Occurrence: Four (4) times.

.2 Length: Half Day.

.3 Objective: Walk through new system. Demonstrate each type of control loop. Review each process area in depth demonstrating typical operation of each area. Respond to questions as required. Review of new alarm management system. Provide all training required to operate PCS systems. Make time available for questions and provide answers.

.4 Training must occur before handing area over to City for operation.

.5 Electrical and Instrumentation Maintenance Training:

.1 Occurrence: Three (3) times.

.2 Length: Half days.

.3 Objective: Walk through new hardware installed. Review drawings and how information is presented. Visit each new panel and show the installation and additional field wiring added. Provide all training required to troubleshoot and fix hardware or wiring issues.

.6 Software Maintenance Training:

.1 Occurrence: Two (2) times.

.2 Length: Half day.

.3 Objective: Review new systems. Review programming methodology. Review standardized logic and HMI graphics. Run a full day tutorial on creating a new compound control loop using the standardized blocks and HMI graphics in a style that matches existing system. Review in detail the PLC control logic and documentation for each area.

3.8 City Access

.1 To facilitate and maintain the plants treatment capabilities, the City shall have super user administrative access to all live system component at all time. Submit system administrative user accounts and passwords in sealed envelopment to City with in five (5) business days of creation or change.

.1 A Field Instruction will be provided to the Integrator each incident the City is required to modifying the working applications to maintain plant functionality.

.2 The Integrator may maintain the City's changes or can implement their own correction.

3.9 Contract Closeout

.1 Provide in accordance with Section 01 78 00.

END OF SECTION

FAT AND SIFT PROCEDURES

1. GENERAL

1.1 Description

.1 Factory Acceptance Tests (FAT) and System Integration Functional Tests (SIFT) for the PLC, RIO, and all panels under this project.

.2 Perform FATs at the Contractor's facility before shipping to site. Demonstrate to the Contract Administrator that the PCS, PLC, and/or RIO satisfies the project requirements as documented in the specifications, drawings, and appendices.

.3 Perform SIFTs as well at the Contractor's facility before shipping to site. Demonstrate to the Contract Administrator that the integration of all PCS components including PLCs, HMI software, automation and instrument components, electrical system components, vendor packaged systems, and other miscellaneous subsystems.

.4 The FAT and SIFT testing shall be arranged such that up to four (4) City of Winnipeg or Contract Administrator representatives can attend each testing session at the Contractor shop at no additional charge.

.1 If FAT and SIFT testing occurs further than 100 km outside of Winnipeg:

.1 Provide hotel accommodations, including a room for each representative, for each day of testing.

.2 Allow for travel costs including milage and/or flight costs for each representative.

.2 FAT and SIFT testing shall demonstrate all specified functionality in the Specifications and Drawings

.3 Submit FAT test report for Contractor Administrator's approval. Clearly summarize all SIFT tests conducted.

1.2 Submittals

.1 Submit the following in accordance with Section 01 33 00:

.2 Test Plan:

.1 FAT Plan:

.1 Prepare and submit FAT plan to the Contract Administrator two (2) months prior to scheduled testing for review and approval. Equipment requiring a FAT plan includes the PLCs.

.2 The FAT Plan shall at a minimum include:

.1 Scope of test including all components under test. This shall include hardware, software, programming, configuration, documentation, etc.

.2 Quality of construction, including visual inspection, wiring, labelling, conformance with project requirements, comparison to shop drawings.

.3 Review performance of application software and related functions.

.4 IO Testing.

.5 Operator Interface Functionality Testing.

.6 Review of programming, graphic displays, and database completeness.

.7 Review of software and firmware versions.

.8 Review of test performed by the Contractor prior to the FAT. Review to include confirmation that the testing was complete and passed. FAT testing will halt if there is evidence that pre-testing was not completed.

.9 Demonstration plan and schedule for all items not able to be covered by the FAT.

.10 Test plan including all test procedures.

.2 SIFT Plan:

.1 Prepare and submit to the Contract Administrator two (2) months prior to scheduled testing for review and approval. SIFT will not start until the FAT report has been approved by the Contract Administrator.

.2 The SIFT Plan shall at a minimum include:

.1 Scope of tests, including hardware, software, application software, configuration, documentation, etc.

.2 List of all interfacing systems to the items under test.

.3 Test and demonstration methodology to each interfacing system.

.3 The Contractor shall provide the facility and tools required to perform all FAT and SIFT activities.

.4 Contractor shall conduct a full in-house test before FAT and submit test report to Contract Administrator.

.1 FAT and SIFT will be rescheduled if the test before FAT are failed.

2. PRODUCTS (NOT USED)

3. EXECUTION

3.1 FAT

.1 Required Documentation:

.1 Provide the following documentation on printed copies at the test facility.

.1 Process Control Narrative.

.2 Existing Area Logic (for PLCs or controllers being modified).

.3 New Area Logic.

.4 P&IDs.

.5 HMI Layout and Animation Plan.

.6 Existing Screens (for Screens being modified).

.7 New Screens.

.8 I/O List.

.9 Control System Architecture Drawings.

.10 HMI Architecture.

.11 As-built Shop Drawings.

.12 Pre-FAT reports.

.13 Draft O&M Manuals.

.14 PLC and HMI Program documentation.

.15 Software licence information.

.16 CPU, Network, and Server loading reports.

.17 Hardware and Software configuration parameters.

.2 Test Procedures:

.1 The Tests shall include at a minimum:

.1 Control Panel Inspection:

.1 Visual Inspection.

.2 Verification of Panel Layout.

.3 Warning and nameplate labels.

.4 Verification of component tags.

.5 Cabinet internal grounding.

.6 Verification of component part numbers.

.7 Cabinet Lighting and fans.

.8 Spare Capacity.

.2 Wiring Inspection:

.1 Wire Tags.

.2 Fusing and Circuit Breakers.

.3 Segregation of different wirings according to shop drawings and specifications.

.4 Wire duct loading.

.5 Random wire crimp inspection and random manual wire pull test.

.6 Power supply and distribution.

.3 Start-up testing and general Control System function testing:

.1 Cold start-up.

.2 On-line change to configuration/program.

.3 Controller cycle time.

.4 Display call-up time.

.5 Value update time.

.6 System load.

.7 Time synchronization check.

.8 User log-on security and security levels.

.9 Back-up power supply operation.

.4 System alarm testing:

.1 Alarm philosophy and acknowledgment.

.2 Power supply failure alarm.

.3 Priority levels of alarms.

.4 System diagnostic alarms.

.5 Network alarms.

.6 Wire break, short circuit, out of range, earth fault.

.7 Watchdog.

.8 Electrical fault and status alarms.

.5 Hardware redundancy testing:

.1 PLC redundancy.

.2 Power supply redundancy.

.3 Redundancy of process control networks, subnetworks, and field networks for installed work.

.6 HMI testing:

.1 Symbols for process equipment.

.2 Colors.

.3 Process flow direction.

.4 Hierarchies and linking displays.

.5 Dynamic changes of colors, sub-pictures and data entry points.

.6 Density of information.

.7 Static text and dynamic changes.

.8 Alarm demonstration.

.7 Device interface HMI testing:

.1 The Device faceplate shall be checked as follows to confirm required appearance and functionality:

.1 Functionality, service text, range, units, etc.

.2 Link to physical or communications I/O point/address.

.3 Related process group display.

.4 Related trends.

.2 Color changes for dynamic objects, for example, valves, motors bar graphs, etc. shall be checked.

.3 Location of tag targets on the graphics shall be checked to be in correct location.

.4 Alarm assignments: Type, value, priority, etc. shall be checked.

.5 Alarm E-mail notification shall be checked (if practicable).

.8 Hardwired I/O function testing:

.1 Full functionality of I/Os shall be tested by simulation device or simulation software.

.2 Complete loop check test form templates for each point.

.3 The most complete I/O testing method is to connect simulation devices to field terminals.

.4 If the above method is not possible, then simulation devices may be connected to I/O modules, or I/O modules software simulation may be used.

.5 I/O simulation software shall provide I/O simulation for Schneider M580 PLCs.

.9 Bus device function testing:

.1 Full functionality of bus devices shall be tested by simulation device or simulation software.

.2 The most complete bus device testing method is to connect simulation devices to fieldbus network.

.3 If the above method is not possible, then simulation software may be used.

.10 Bus interface link testing:

.1 Selected bus segments which are agreed upon, interfaces should be built up and tested with all segment devices.

.2 This test should cover interoperability of the Control System and the device.

.3 Signals related to segments not built up should be simulated.

.4 All relevant segment documents should be reviewed.

.5 Functionality of bus protection devices shall be tested.

.3 Record all defects, non-compliance items, or incomplete work. Include description of issue, resolution, and date completed.

.4 All issues shall be rectified during the FAT if feasible.

.5 Documentation

.1 Provide completed checklist including measured values for signing upon the completion of the FAT. Include a list of the defective, non-conformance, or incomplete work items.

.6 FAT Completion:

.1 Create a FAT test report upon completion of all FAT testing activities demonstrating and verifying all functionality as laid out in the FAT plan. Submit FAT test report for Contract Administrator's review.

.2 The FAT shall be considered complete when all required functions have been tested and verified according to FAT plan, and the Contract Administrator has reviewed and accepted the FAT test report.

.3 Any tests that could not be completed during the FAT shall be completed at Site Acceptance Test (SAT) during pre-commissioning activities.

3.2 SIFT

.1 Required Documentation:

.1 Provide the following documentation on printed copies at the test facility.

.1 Process Control Narratives.

.2 Existing Logic (for modifications to existing PLCs or controllers).

.3 New Logic.

.4 P&IDs.

.5 HMI Layout and Animation plan.

.6 Existing HMI screens (for modifications to existing PLCs or controllers).

.7 New HMI Screens.

.8 I/O List.

.9 Control system architecture.

.10 HMI architecture.

.11 PLC and HMI program documentation.

.12 Associated vendor panel documentation.

.2 Test Procedure:

.1 Communication links to subsystems (vendor package control system, Electrical systems and other subsystems) shall be tested.

.2 If actual connection to all Electrical systems is not possible, one typical connection to the electrical equipment (VFD, MCC, Power meter, etc.) shall be tested.

.3 If actual connection to subsystem is not possible, subsystem simulation device or software shall be used.

.4 Full functionality of link shall be tested as far as practicable.

.5 Link failure effects and redundancy functions shall be tested.

.6 Control System HMI functionality shall be tested for all control systems, electrical systems and other subsystems.

.7 The initial data, setpoints and settings shall be tested during the redundancy check.

.8 Interlocks and complex function testing:

.1 Complex functions, interlocks and operating modes shall be tested after the I/O tests to satisfy requirements of Process Control Narrative and DCS Logic documentation.

.9 Process simulation:

.1 Test and validate the process plant operation by using process and equipment models created with process simulation software.

.3 Record all defects, non-compliance items, or incomplete work. Include description of issue, resolution, and date completed.

.4 All issues shall be rectified during the SIFT if feasible.

.5 Documentation:

.1 Provide completed checklist including measured values for signing upon the completion of the SIFT. Include a list of the defective, non-conformance, or incomplete work items.

.6 SIFT Completion:

.1 The SIFT shall be considered complete when all required functions have been tested and verified according to SIFT plan.

.2 Any tests that could not be completed during the SIFT shall be completed at Site Acceptance Test (SAT) during pre-commissioning activities.

3.3 Contract Closeout

.1 Provide in accordance with Section 01 78 00.

END OF SECTION

AUTOMATION TESTING AND COMMISSIONING

1. GENERAL

1.1 Description

.1 Provide all testing and commissioning for all Process Control System (PCS) and automation components necessary to confirm the functional performance for the equipment and systems, include complete commissioning and demonstration of the new work integrated and working on the existing PCS.

.2 Perform a Site Acceptance Test (SAT) at site prior to commissioning to demonstrate that the installation satisfies the project installation requirements and applicable codes and standards.

.3 Perform a Site Integration Test (SIT) at site to demonstrate that all the control system components are fully integrated and working together as specified in the project documents as required for complete PCS functionality.

.4 Testing is performed to:

.1 Demonstrate and document that the entire PCS is operating in accordance with the design requirements;

.2 Contribute to the safe and reliable operation of the plant; and

.3 Provide a baseline result for routine maintenance of system and related components.

1.2 Submittals

.1 Submit the following in accordance with Section 01 33 00

.2 Submit SAT plans and schedules a minimum of two (2) months prior to testing.

.3 Submit commissioning plans and schedules a minimum of two (2) months prior to testing.

.4 SAT Plan:

.1 Contractor shall submit the SAT plan for Contract Administrator review and acceptance.

.2 The SAT plan provided by Contractor shall include:

.1 Scope of the test, including hardware, software, programming, configuration, documentation etc.

.2 Hardware, including construction, visual inspection, wiring, labeling, agreement with shop drawing requirements and acceptance criteria.

.3 Software, including the loaded application and HMI software and the configuration.

.4 Hardware and software configurations shall comply with the FAT and SIFT results.

.5 FAT and SIFT functional tests to be re-performed after installation.

.6 Tests that were not completed during the FAT/SIFT and any open FAT/SIFT punch list item.

.7 Tests to be performed after loop checks such as interlock, logic and sequence check.

.8 Security of all installed equipment on the PCS networks and subnetworks (fire wall rules and network segmentation).

.5 SIT Plan:

.1 Contractor shall submit the SIT plan for Contract Administrator approval.

.2 The SIT plan provided by Contractor shall include:

.1 Scope of the test, including hardware, software, programming, configuration, documentation etc.

.2 Tests to confirm interoperability of systems involved.

.3 Any functional test to be re-performed after interface to package control system.

.6 Supplement submittal documentation as needed to provide adequate records of testing and commissioning activities in accordance with accepted industry practice.

.7 Issue submittals for Contract Administrator review and acceptance in accordance with the project schedule as defined herein and in a timely manner to ensure that all required documentation is in place prior to the commencement of any testing or commissioning activities.

.8 Coordinate the submittals detailed in other sections of the specifications with the requirements defined in this section to achieve a complete set of documentation without overlap or gaps.

2. PRODUCTS

2.1 Testing Equipment

.1 Typical test equipment to perform test, configuration, calibration and loop checks include but are not limited to:

.1 Digital multimeter.

.2 Portable pressure calibrator.

.3 Dead weight tester.

.4 Precision pressure gauge.

.5 Temperature calibrator.

.6 Temperature calibration bath.

.7 Standard temperature sensor and meter.

.8 Loop calibrator.

.9 Hand-held oscilloscope.

.10 Ethernet fiber and copper network tester.

.11 Profibus PA and DP segment tester.

.12 Profibus PA hand-held field communicator.

.13 HART hand-held field communicator if applicable.

.14 Two way radio.

2.2 Testing Equipment Calibration

.1 Contractor shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.

.2 The firm providing calibration services shall maintain up-to-date instrument calibration instructions and procedures for each test instrument calibrated.

.3 Instruments shall be calibrated in accordance with the following frequency schedule:

.1 Field instruments analog and digital: 12 months maximum;

.2 Laboratory instruments: 12 months maximum;

.3 Leased specialty instruments: 12 month maximum.

.4 Dated calibration labels shall be visible on all test equipment.

.5 Calibrating standard shall be of better accuracy than that of the instrument tested.

3. EXECUTION

3.1 General

.1 The testing and commissioning activities described herein applies to all components and systems that make up the entire Process Control System for the work provided under this project.

.2 All test reports shall include:

.1 The date,

.2 The name, title, and company of the personnel performing the test. Document any required qualifications held.

.3 The conditions during the test as applicable (weather, process conditions, etc.)

.4 The name, title, and company of the representative observing the test.

3.2 Qualification of Personnel

.1 The personnel performing the field tests and commissioning shall be experienced and thoroughly familiar with the apparatus and systems being tested and commissioned. They shall be capable of conducting the tests and commissioning activities in a safe manner, analyze the test data and make a decision on operability of specific equipment and system.

.2 The Contract Administrator shall witness the testing and commissioning.

.3 City of Winnipeg representatives shall observe the testing and commissioning.

3.3 Commissioning Preparation

.1 Carry out all testing and pre-commissioning activities as required herein.

.2 Coordinate all pre-commissioning schedules with the Contract Administrator.

.3 Keep accurate records of all works completed and submit final documentation for each pre-commissioning activity as and when completed for each portion of the project. Certify all final submissions as accurate and true.

.4 Review FAT and working copies of the construction documents to verify the condition is acceptable and suitable for commissioning.

.5 Prepare Commissioning Plan.

.6 Submit Commissioning Plan for review and approval by Contract Administrator.

.7 Coordination and schedule and manufacturer’s assistance as required.

.8 Provide any manufacturer’s instructions in the commissioning plans.

.9 Loop Checks:

.1 Perform loop checks to verify proper operation of all loops prior to commissioning.

.2 Check Documentation.

.3 Visually inspect the installation.

.4 Verify the loop functionality.

.10 Instrument system tests:

.1 Demonstration of operation of all equipment in all control modes as documented in the Process Control Narratives.

.11 SAT:

.1 Perform the SAT to demonstrate proper functionality of the system at final installation.

.2 Check of Hardware/Software inventory;

.3 Mechanical inspection;

.4 Wiring and termination inspection;

.5 System energization;

.6 Checking hardware redundancy and diagnostic;

.7 Checking operator interface;

.8 I/O test;

.9 Verification of the device network interfaces;

.10 Function check; and

.11 .Performing the tests which could not be completed during the FAT.

.12 SIT:

.1 Perform the SIT to demonstrate the functionality and compatibility of all interconnected systems at final installation to achieve the Process Control System required performance The SIT consists of testing the communication and interaction between the PCS sub-systems or with other systems, such as mechanical package control systems, to ensure desired functional performance. The SIT shall be performed after the SAT for each system/sub-system has been successfully completed.

.2 Mechanical inspection;

.3 Testing communication links;

.4 Checking operator interface;

.5 Testing Hardwired I/O;

.6 Functional tests; and

.7 Performing the tests that could not be completed during the SIFT.

.13 Produce test reports for all performed tests and results and provide in the O&M Manuals.

3.4 Commissioning

.1 Carry out all testing and commissioning activities as required herein.

.2 Coordinate all commissioning schedules with the Contract Administrator.

.3 Keep accurate records of all works completed and submit final documentation for each commissioning activity as and when completed for each portion of the project. Certify all final submissions as accurate and true.

.4 Reviewing commissioning plan;

.5 Reviewing pre-commissioning reports to verify acceptable condition for commissioning phase;

.6 Perform Loop Functional Checks;

.1 See Appendix D for loop check test form templates.

.2 Demonstrate equipment functionality as described in the Commissioning Plan. Minimum requirements shall demonstrate all functionality in the Process Control Narratives and specifications.

.3 For analog signals use 4-20 mA sources to simulate the transmitter signal. For Profibus instruments, use a handheld communicator connected at the transmitter to simulate the signal. For discrete signals, simulation includes the use of a jumper or lifting a wire/opening a fuse in the circuit.

.4 Simulate values at multiple points (in both increasing and decreasing directions) of transmitter span (0, 25, 50, 75 and 100%) to confirm the sensor/transmitter, HMI and any other indicators all agree.

.5 Simulate values above and below range to confirm failure reaction in PCS. Simulate a sensor/transmitter failure and/or disconnection to verify the failure reaction in PCS.

.6 Reconnect the transmitter to verify the device is automatically and correctly communicating with PCS. Final alarm and control set point adjustments as necessary;

.7 Interlock Verification:

.1 Force each interlock initiator, one at a time, and confirming that all interlock actions occur at the proper trip points in accordance with the Process Control Narratives.

.8 Sequence Logic Check:

.1 Demonstrate all sequence logic and control loops as described in the Process Control Narrative. Force each sequence logic or control loop initiator, one at a time, and confirming that all logic actions occur properly in accordance with the Process Control Narrative.

.9 Adjustments of controller’s PID value (Loop Tuning) as necessary;

.10 Verification of complex control schemes;

.11 Demonstrate and monitor PCS diagnostic alarms;

.12 Monitor the control system performance for any system failures during testing and operation. System failures include but are not limited to server errors and warnings, and network health;

.13 Commissioning of analyzers, sample handling systems and other special instruments;

.14 Create a Commissioning report upon completion of all commissioning activities demonstrating and verifying all functionality as laid out in the commissioning plan. Include tests and demonstrations performed, measured values, system response, and tuned values.

.1 Submit Commissioning Report for Contract Administrator's review and acceptance.

3.5 Contractor Representative

.1 Designate and furnish one or more Contactor personnel to coordinate and expedite all testing and commissioning activities and documentation functions.

.2 Contractor representative(s) to coordinate all testing and commissioning works carried out by specific equipment vendors in accordance with the commissioning planning and schedules submitted by the Contractor.

.3 Representative(s) to attend all meetings concerning the commissioning function as may be requested by the Contract Administrator. Representative(s) to be available at all times during the testing, pre-commissioning, commissioning and performance evaluation phases of the project.

3.6 Contract Closeout

.1 Provide in accordance with Section 01 78 00.

END OF SECTION

MAINTENANCE AND SUPPORT

1. GENERAL

1.1 Maintenance Services

.1 Maintain equipment per manufacturer's recommendations up to the final completion of the construction.

1.2 Support Services

.1 Duration:

.1 The duration of support services is to extend during the warranty period (one (1) year past Total Performance).

.2 Requirements:

.1 Provide telephone support for all products supplied (during regular business hours).

.2 Respond to emergency service calls (during regular business hours).

.3 Telephone Support:

.1 Telephone support to utilize service personnel knowledgeable in the products and have the required troubleshooting skills.

.2 No payment will be made for telephone support during the warranty period.

.4 Emergency Service Calls:

.1 Respond to service calls from the City when the system is not functioning correctly.

.2 Qualified control personnel to be available to provide on-site service upon a critical failure, whenever required.

.1 A critical failure is the inability to operate of any part of the critical system supplied or modified by the Contractor.

.2 Critical systems include, but are not limited to:

.1 Communication networks.

.2 MCC.

.3 PLC and RIO systems.

.3 Perform work continuously until system is restored to a reliable operating condition.

.4 Response Time:

.1 The response time to emergency service calls is to be less than four hours.

.5 Record each service call request, when received separately and include:

.1 Serial number identifying component involved.

.2 Location, date, and time call received.

.3 Nature of trouble.

.4 Names of personnel assigned.

.5 Instructions of work to be done.

.6 Amount and nature of materials used.

.7 Time and date work started.

.8 Time and date of completion.

.6 Costs:

.1 If the issue is determined to be due to poor workmanship or defect of the Contractor, no payment will be made to the Contractor.

.2 If the issue is determined to be due to failure of a physical component supplied and is covered under manufacturer's warranty, no payment will be made to the Contractor.

.3 If the issue is determined to be due to an issue outside of the Contractor's responsibility, the Contractor will not be paid for the service call to the Site (or for estimating the required work), but will be paid a mutually agreed upon value to correct the issue, at the discretion of the City.

2. PRODUCTS (NOT APPLICABLE)

3. EXECUTION (NOT APPLICABLE)

END OF SECTION

BIN COVERS

1. GENERAL

1.1 Description

.1 Provide and test two (2) self-contained leveling bin covers to evenly distribute and cover a nominal 20 yd. waste container.

.2 Provide two (2) 316 SS chutes directing the sludge cake from the press discharge to the bin cover inlet opening.

1.2 References

.1 ASTM International (ASTM):

.1 A36/A36M: Standard Specification for Carbon Structural Steel.

.2 A48: Specification for Gray Iron Castings.

.2 American National Standards Institute (ANSI):

.1 S1.11: Specification for Octave, Half-Octave, and Third-Octave Band Filter Sets.

.3 National Electrical Manufacturers Association (NEMA):

.1 MG1: Motors and Generators.

1.3 Submittals

.1 Submit the following Shop Drawings in accordance with Section 01 33 00:

.1 Data regarding equipment performance and motor characteristics and performance:

.2 Drawings showing materials of construction, thicknesses, operating and maintenance envelope and assembly and component weights.

.3 General arrangement drawings, plan and section showing conveyors, gate, chutes, supports and all process equipment interfaces.

.4 Shop drawing data for accessory items.

.5 Certified setting plans, with tolerances, for anchor bolts.

.6 Manufacturer's literature as needed to supplement certified data.

.7 Operating and maintenance instructions and parts lists.

.8 Listing of reference installations as specified with contact names and telephone numbers. Conveyor torque requirement calculations.

.9 Torque calculations for the gear reducer and reducer motor.

.10 Horsepower calculations for the drive motor(s).

.11 Bearing temperature operating range for the service conditions specified.

.12 List of recommended spare parts other than those specified.

.13 Shop and field inspection reports.

.14 Bearing Life: Certified by the equipment manufacturer. Include design data.

.15 Equipment shop test results.

.16 Motor shop test results.

.17 Qualifications of field service engineer.

.18 Recommendations for short and long-term storage.

.19 Shop and field testing procedures, set up and equipment to be used.

.20 Special tools.

.21 Gear reducer data including service factor, efficiency, torque rating and materials

.22 Control Panel:

.1 Front elevations, with and without door.

.2 Elementary wiring connection diagram.

.3 Catalog sheets for devices in the control panel.

.4 Use NEMA device designations and symbols for electric circuit diagrams. Make contents of elementary connection diagrams in accordance with NEMA ICS 1.

.5 Manufacturer’s standardized elementary diagrams will not be acceptable unless applicable portions of the diagram have been clearly identified and non-applicable portions deleted or crossed out.

.23 Number of service person-days provided and per diem field service rate.

.24 Manufacturer’s product data, specifications and color charts for shop painting.

.25 Provide listing of reference installations with contact names and telephone numbers.

.26 List of recommended spare parts other than those specified.

.27 Equipment weight and lifting points for installation and removal purposes.

.28 Provide a listing of the materials recommended for each service specified and indicated. Provide documentation showing compatibility with process fluid and service specified and indicated.

.29 The latest ISO 9001 and 14001 series certification.

.30 Provide a scaled drawing showing the equipment, motors, hoists and bridge cranes including equipment weights, lifting attachments, slings and clearances for equipment removal and maintenance.

.31 Number, size and weight of pieces shipped.

.32 Material Certification:

.1 Provide certification from the equipment manufacturer that the materials of construction specified are recommended and suitable for the service conditions specified and indicated. If materials other than those specified are proposed based on incompatibility with the service conditions, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated including an installation list of a minimum of twenty-five (10) installations in operation for a minimum of five (5) years. Provide proposed materials at no additional cost to the City.

.2 Where materials are not specified, provide technical data and certification that the proposed materials are recommended and suitable for the service conditions specified and indicated.

.2 A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with “No changes required” or provide a statement that no changes are required.

.1 Failure to include all drawings or a statement applicable to the equipment specified in this section will result in submittal return without review until a complete package is submitted.

.3 A copy of this specification section with addenda and all referenced specification sections with addenda, with each paragraph check-marked to indicate specification compliance or marked and indexed to indicate requested deviations and clarifications from the specified requirements.

.1 If deviations and clarifications from the specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

.2 Failure to include a copy of the marked-up specification sections and or the detailed justifications for any requested deviation or clarification will result in submittal return without review until marked up specifications and justifications are submitted in a complete package.

1.4 Spare Parts

.1 Comply with the requirements specified in Section 01 61 00.

.2 Provide spare parts that are identical to and interchangeable with similar parts installed.

.1 Furnish following spare parts:

.1 One (1) set of all special tools required.

1.5 Quality Assurance

.1 Comply with the requirements specified in Section 01 45 00.

.2 Equipment furnished in this specification shall be fabricated and assembled in full conformity with this specification and as shown in the contract drawings. Each unit shall be furnished complete with all supports; all mechanical equipment required for proper operation, including complete drive units; all steel, iron, and other metal construction specified herein; and all additional materials or fabrication as required by the supplier's design.

.3 The bin cover equipment shall include, but not be limited to the following:

.1 Container Cover.

.2 Spiral flighting.

.3 Troughs and Liners.

.4 Chutes.

.5 Covers.

.6 End Shaft.

.7 End Seals.

.8 Motor Reducer.

.9 Mounting and Support Structure with automated tilting.

.10 Level Indication.

.11 Guide rails and stops.

.12 Electrical Controls.

.13 Safety Accessories.

.14 Heat Tracing.

.4 Equipment specified shall be manufacturer’s standard cataloged product and modified to provide compliance with the drawings, specifications and the service conditions specified and indicated.

.5 Welding: In accordance with latest applicable American Welding Society Code or equivalent.

.6 Shop tests as specified.

.7 Services of Manufacturer's Representative as stated in Section 01 45 00 and as specified herein.

.8 Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

.1 Service Technician must have a minimum of five (5) years of experience, all within the last seven (7) years, on the type and size of equipment.

.2 Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

.3 Installation: Inspect grouting, location of anchor bolts; setting, leveling, alignment, field erection; coordination of electrical and miscellaneous utility connection:

.1 1 person-days.

.4 Functional Testing: Calibrate, check alignment and perform a functional test. Tests to include all items specified.

.1 1 person-days.

.5 Field Performance Testing: Field performance test equipment specified.

.1 1 person-days.

.6 Vendor Training: Provide classroom and field operation and maintenance instruction including all materials, slides, videos, handouts and preparation to lead and teach classroom sessions.

.1 0.5 person-days.

.7 Credit to the City, all unused service person-days specified above, at the manufacturer’s published field service rate.

.8 Any additional time required of the factory trained service technician to assist in placing the equipment in operation, or testing or to correct deficiencies in installation, equipment or material shall be provided at no additional cost to the City.

.9 Manufacturer of specified equipment shall have a minimum of ten (10) operating installations with equipment of the size specified and in the same service as specified operating for not less than five (5) years.

.10 If equipment proposed is heavier or taller, different width, or discharge arrangement than specified and indicated; provide all structural, architectural, mechanical, electrical and plumbing revisions at no additional cost to the City.

.1 If equipment is heavier than specified, the Contractor shall provide all hoisting equipment sized to maintain the minimum safety factor between the specified maximum equipment weight and the lifting capacity of the hoisting equipment indicated and specified.

.11 Electrical Equipment Labeling Requirements:

.1 Provide equipment labeled by a nationally recognized testing company where standards have been established. Where equipment is not available with label, provide service of a nationally testing company to examine the equipment and certify in writing that it complies with its safety standards. Tests and inspections of equipment shall be at no additional cost to City.

.12 Provide all components made of stainless steel passivated by full submergence in a pickling bath for perfect surface finishing. No stainless steel components may be fabricated or assembled in a factory where carbon steel products are also fabricated, in order to prevent contamination by rust.

.1 Fully submerge all stainless steel parts in a pickling bath for at least eight (8) hours to remove welding spots and to protect the stainless steel against corrosion. Sand or glass bead blasted or brushed or otherwise not equivalently treated stainless steel is not acceptable.

.13 Provide fabrication in compliance with all applicable ASTM standards or equivalent international standards.

.14 Factory welding to use shielded arc, inert gas, MIG or TIG method.

.1 Filler wire: Add to all welds to provide for a cross section equal to or greater than the parent metal.

.2 Butt welds: Fully penetrate to the interior surface and gas shielding to interior and exterior of the joint.

1.6 Manufacturer

.1 All equipment included in this section shall be furnished by a single supplier who shall be responsible for the design, coordination, and the satisfactory operation of the system.

.2 Materials, equipment, and accessories specified in this section shall be:

.1 Level LODOR™ system as manufactured by JDV Equipment, Dover, New Jersey including all equipment, materials and appurtenances necessary and as specified herein. The contractor shall submit the JDV equipment as part of the base bid.

.2 or approved equal.

.3 Any re-design required to accommodate alternate bid equipment shall be borne by the contractor and equipment manufacturer.

.4 The shaftless screw conveyors shall be manufactured by a supplier with not less than ten (10) operating installations of the automatic bin covers in North America.

.5 The Supplier shall acknowledge that he is familiar with all the requirement of the contract documents relevant to the equipment supplied herein and agrees to perform and observe all obligations under the contract documents which relates to the portion of the work covered by this section and related sections.

.6 The Supplier of the material and/or products included in this section undertakes and agrees to defend, at Supplier's own expense, all suits, action or proceeding brought against the municipality or it's Contractor(s) for actual or alleged infringement on any United States patent or foreign letters patent because or on account of the employment of sales of such material or products, and further agrees to pay and discharge any and all judgments or decrees which may be rendered in any such suit, action or proceeding against the defendants herein.

1.7 Delivery, Storage and Handling

.1 Comply with the requirements specified in Section 01 61 00.

2. PRODUCTS

2.1 General Equipment

.1 All products supplied shall meet the following as a minimum intent of supply.

.1 Power supply - Power supply to the equipment will be 208 volts, 60 Hz, 3 phase. Power supply for controls shall be 120 volts, 60 Hz, single phase.

.2 Electrical Equipment - All electrical equipment shall conform to applicable standard of the National Electrical Manufactures Association (NEMA) and the National Electrical Code (NEC). Both power and control equipment shall be insulated for not less than 600 volts even though operating voltages may be lower. All motors shall be totally enclosed, fan cooled (TEFC). Control panels shall be NEMA 4X, stainless steel.

.3 Fabrication - All welds shall be continuous unless otherwise specified. Facing surfaces of bolted joints shall be shop primed. Facing surfaces of field welded components shall be beveled and match marked.

.4 Edge Grinding - Sharp corners of all cut and sheared edges shall be made smooth by a power grinder.

.5 Fasteners - All bolts, nuts, washers, and other fasteners shall be AISI 316 stainless steel.

.6 Surface Preparation - All iron and mild steel surfaces to be painted shall be dry abrasive grit blasted to "near white metal" in accordance with SSPC-SP6 or SSPC-SP10, and in accordance with the painting section of these specifications. Grit blasted surfaces shall be painted within twenty-four (24) hours to prevent rusting and surface discoloration.

.7 Painting. - After surface preparation, metal surfaces except for the spiral flighting shall receive a minimum of one (1) coat of Tnemec "66-1211 Epoxoline primer" or equal, and one (1) coat of "46H-413 Hi-Build Tnemec-tar" coal tar epoxy or equal, to provide a total minimum dry film thickness of 15 mils prior to shipment to jobsite. Stainless steel components shall be furnished unpainted.

2.2 Performance and Design Requirements

.1 The bin cover system shall be designed to meet the following minimum performance and design requirements. The standards for conveyor selection shall be based on the operational experience of the manufacturer with shaftless screw conveyors, and not standards developed for shafted screw conveyors.

.1 Schedule of Leveling System(s):

Parameter	Bin Cover No. 1	Bin Cover No. 2
kg per Hour	150	150
Material	Dewatered Sludge	Dewatered Sludge
Max Solids %	60-65	60-65
Container Size, CY	20	20
Max Screw Speed RPM	25	25
Max Trough Fill	50%	50%
Min Flight OD	300 mm	300 mm
Min Spiral Weight per ft	27	27
Minimum Trough Width	312	312
Minimum HP	3	3
Drive Location	Inlet End	Inlet End
Motor Type	TEFC	TEFC
Reversing Screw	None	None

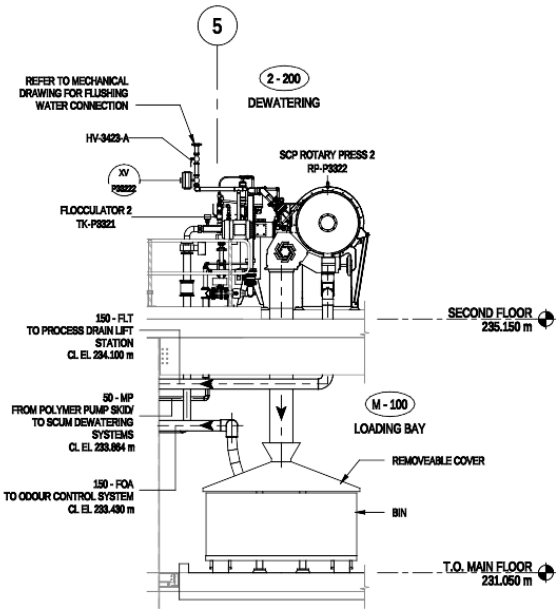
2.3 Materials

.1 Unless otherwise specified or permitted, the materials used in the fabrication of the equipment under this section shall conform to the following:

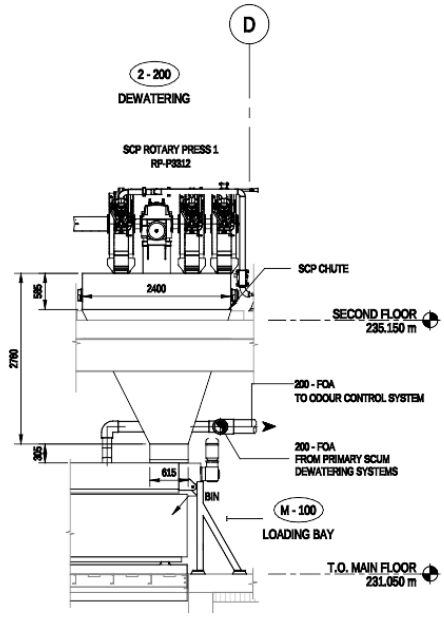
Inlet Chutes	AISI 316, ASTM A167, 18-8
End Plates, Covers	AISI 316, ASTM A167, 18-8
Container Supports	AISI 316, ASTM A167, 18-8
Spiral Flighting	High Strength Alloy Carbon Steel with scheduled 40 center support shaft
Bolts, Nuts, and Washers for Conveyor Supports	AISI 316, ASTM A167, 18-8
Conveyor Channel Stiffeners	AISI 316, ASTM A167, 18-8
Container Guide Rails	AISI 316, ASTM A167, 18-8

2.4 Sludge Cake Chutes

.1 Provide two (2) 316 SS chutes directing the sludge cake from the press discharge to the bin cover inlet opening as shown on Drawings complete with gasketing and all connection appurtenances as necessary.



2 | SLUDGE CAKE CHUTE
1-0101-PGAD-P311-001 | SCALE: 1:50



3 | SLUDGE CAKE CHUTE
1-0101-PGAD-P311-001 | SCALE: 1:50

2.5 Container Cover

.1 Components of the cover shall include truss/support assemblies, cover plates, purlins and conveyor designed to allow water to drain off top. Cover plates to be a minimum of 3/16". Cover to be designed to allow pivoting without excessive deflection. The cover shall include at a minimum, the following:

.1 One (1) flanged odor control connection, 6”.

.2 One (1) flanged connection for ultrasonic sensor, 8”.

.3 One (1) Level sensor.

.4 One (1) inspection hatch.

2.6 Shafted Transport Conveyor

.1 Spiral flighting for the shafted screw conveyors shall be designed to convey material with use of a center shaft. The minimum overall spiral weight and surface pressure shall be as specified herein. The conveyor will include an inner flight to increase axial strength and capacity of the conveyor. The minimum spiral weight shall be specified herein.

.2 Spiral flights shall be Carbon Alloy steel 12” diameter, full pitch with ¼ to 3/8” thick sectional flight continuously welded on the carry side to 3 to 3 ½” scheduled 40 pipe. Both ends of the pipe shall be bushed for minimum 2-7/16” diameter C1045 CFS Shafting and drilled with 2 holes for min ½” bolts.

.3 One (1) hanger bearings shall be provided with Hard-Iron bearings with coupling shafts with hardened surface in the bearing area. Hanger bearing may not be required should the design of the shaft tube be sufficient to withstand deflection limits.

.4 The connection of the spiral to the drive system shall be through a bolted connection.

.1 The connection of the conveyor from the drive system shall utilize a drive shaft fitted into the end conveyor shaft. The conveyor shaft shall be a bushed and bored fit utilizing two ½" bolts for coupled fastening to the drive assembly shaft. Drive systems utilizing flanged or flexible coupling fits shall not be allowed.

2.7 Horizontal Conveyor Guide Channel

.1 Stiffeners shall be placed across the top of the guide channel/cover and fastened to both sides of the cover to maintain shape and act as a face seal for the covers; apply a continuous gasket, one half inch width, to the entire top face of the conveyor channel top flange.

.2 Each conveyor channel section shall be equipped with filling inlet and open discharge as required by the contract drawings. If required, each filling opening shall be flanged suitable for interconnection to other devices. Any interconnecting devices such as chutes and hoppers shall be fabricated from the same material as the conveyor guide channel sections.

.1 The portion of each conveyor channel section that is not covered by the filling chute shall be covered by a bolted cover of a material identical to the conveyor stiffening inner supports. The covers shall be manufactured in maximum four foot length section to allow for access to the conveyors. To prevent unsafe access to the conveyors, quick opening covers will not be allowed.

2.8 Inlet Chutes

.1 Inlet and discharge chutes shall be provided by the conveyor supplier as shown on the drawings. All chutes shall be fabricated from the same material as the conveyor trough.

2.9 Supports

.1 Each Bin Cover shall be furnished complete with supports suitable for mounting as shown on the contract drawings and as required to allow unit to tilt up so dumpster can be removed and replaced. The supports shall be shop fabricated from structural steel shapes and plates, and shall be assembled and fitted to the conveyor prior to its delivery to the jobsite. Supports and conveyor segments shall be match marked and shipped to the jobsite for assembly by the contraction others.

.1 Supports shall be fabricated of AR 36 steel, galvanized or equal.

.2 Minimum width required between the front supports is 3500 mm.

.3 All shop welding shall conform to the latest standards of the American Welding Society (AWS). The supports shall be designed to avoid interference with other equipment or equipment supports.

2.10 Guide Rails

.1 The container rollers shall be guided into position with floor guide rails, one on each side. The guide rails shall be constructed from 3/8" thick stainless steel angle with coped ends to aid with the container alignment.

.1 A 1/2" stainless steel stop plate shall be supplied by the Bin Cover manufacturer and anchored to the floor as per the manufacturer's recommendations.

.2 The 2" high side guides rails shall be installed onto the scale platform.

.3 If needed anchor bolts shall be spaced on 24" centers minimum.

2.11 Electric Hoist

.1 A 1.5 ton electric hoist shall be mounted on front end support. Hoist shall be mounted to support and installed as part of the Bin Cover. General components of the hoist shall meet the following conditions:

.1 Arrange all working parts for convenient inspection, lubrication, adjustment, repair, or replacement. Assemble paint, test, and adjust the equipment, in the shop as far as practicable before shipment.

.2 House the operating machinery and other exposed parts suitably, fabricate the exterior of the unit to have smooth surfaces or pleasing appearance.

.3 Design the hoist with an overload limit device to prevent damage to the equipment or structure if loads in excess of the specified capacity of the hoist are applied.

.4 Place a label, easily readable from the operating floor on each monorail beam showing the rated capacity of the equipment. Provide all appurtenances, caution markers, and appliances necessary to comply with applicable safety laws and codes.

.5 Unless otherwise shown or specified, provide all hoisting equipment suitable for normal indoor and outdoor service as shown.

.6 Design all gearing to meet requirements of CMMA Specification No. 74 and AGMA Standards and of helical or spur type constructed of heat treated steel. Provide worm gears of bronze and with precision machined cut teeth. Provide all pinions of heat treated alloy steel. Enclose or guard gearing and provide either oil bath or splash lubrication.

.7 Design the gear reducer or gear motor specifically for crane service with minimum classification of moderate shock service and with minimum service factor 1.0.

2.12 Structural Design

.1 All structural supporting members shall be designed such that the ratio of the unbraced length to least radius of gyration (slenderness ratio) shall not exceed 120 for any compression member and shall not exceed 240 for any tension member (of angles about Z-Z axis). In addition, all structural members and connections shall be designed so that the unit stresses will not exceed the American Institute of Steel Construction allowable stresses by more than

1/3 when subject to loading of twice the maximum design operating torque of the spiral conveyor drive motors.

2.13 Drive Units

.1 Each spiral conveyor shall be driven by a constant-speed integral gear reducer/motor drive unit mounted to an adapter flange mounted to the end plate of the conveyor. The adapter flange shall allow the leakage of any material from the conveyor trough to atmosphere rather than into the gear reducer/ motor drive unit. Direct coupling of the gear reducer/motor drive unit to the end flange of the conveyor will not be acceptable.

.2 The drive unit shall be rigidly supported so there is no visible "wobble" movement under any operating condition. In the event of a prolonged power failure or emergency system shutdown the drive system shall be designed, at a minimum, to start the conveyor from a dead stop with the trough filled throughout its entire cross sectional area and length with partially dried and hardened dewatered material.

.3 Each motor shall be 204 V, 60 Hz, 3 phase conforming to the General Equipment specifications, except as modified herein. Each motor shall be high efficiency, 40°C ambient rated, 1.15 service factor and shall have Class F insulation. Motor shall have a TEFC enclosure with Design B speed/torque characteristics.

2.14 Gear Reducers

.1 All gears shall be AGMA Class II, single or double reduction, helical gear units with high capacity roller bearings.

.1 Bearings shall be designed for the thrust loads from the fully loaded start-up condition and shall have an AFBMA B10 life of 30,000 hours.

.2 The reducer will be the standard air cooled unit with no auxiliary cooling.

.3 The gear reducer shall be sized with a torque service factor of 1.5 times the absorbed power or 1.1 times the motor nameplate, at the driven shaft speed, whichever is greater.

2.15 Packing

.1 An adjustable greased gland packing ring consisting of two (2) Teflon coated packing rings shall seal the drive shaft at its penetration through the end plate.

2.16 Control Safety Devices

.1 Motion Failure Alarm Unit - Each conveyor drive unit shall be equipped with a motion failure alarm unit. The location and mounting details shall be as recommended by the conveyor manufacturer. Motion sensors shall be the non-contacting type using a probe with a pre-amplifier and main electronic assembly. The main electronic unit shall operate on 120 volt, single phase, 60 Hz power supply, and shall be housed in a NEMA 4X enclosure. A 0 to 60 second time delay shall be provided for start-up of the conveyor.

.2 Emergency Shutdown - Each conveyor shall be furnished with an emergency trip cord and safety switch. The cord shall run the full length of each conveyor. The trip switch shall immediately stop all conveyors when the switch is actuated.

2.17 Controls

.1 The main control panel shall be NEMA 4X supplied by equipment manufacture for wall mounting by the contractor. Power supply shall be 208 VAC, 3 phase, 60 Hertz. Panel shall have the following components as a minimum:

.1 Main Circuit Breaker.

.2 Disconnect Switch.

.3 Motor Starters.

.4 Control Transformer.

.5 H-O-A Switch.

.6 Conveyor Run Light.

.7 Alarm Light.

.8 Dumpster Full Light.

.9 Alarm Horn.

.10 Silence Button.

.11 On/Off Switch for Electric Hoist Controls.

.12 E-Stop.

.2 In addition controls shall include relays and timers to form a complete operational system.

2.18 Shop Painting

.1 Primer and Finish Paint: Shop apply to all exterior ferrous surfaces, high solids epoxy in accordance with Section 09 91 10.

.2 Ferrous surfaces which are not to be painted shall be given a shop applied coat of grease or rust resistant coating.

.3 Provide additional shop paint coating for touch-up to all surfaces after installation and testing is completed and equipment accepted.

2.19 Shop Testing

.1 Comply with the requirements specified in Section 01 65 00 and as specified herein.

.2 Provide motor shop testing in accordance with Section 26 29 10.

.3 Conveyor Testing:

.1 Control Panel Tests:

.1 Test all functions and alarms of each control panel.

.4 Conveyor Tests:

.1 Operate conveyor for thirty (30) minutes and record results.

.2 Fully factory assembly conveyor and operate in the installed position.

.5 Repeat tests until specified results are obtained.

.6 In event that specified tests indicate that equipment will not meet the specifications, Contract Administrator has the right to require complete witnessed tests for all equipment at no additional cost.

.7 Correct or replace promptly all defects or defective equipment revealed by or noted during tests at no additional cost to City.

.8 Provide a thirty (30) day minimum notice prior to testing.

3. EXECUTION

3.1 Installation

.1 Install items in accordance with Shop Drawings with no exceptions noted, manufacturer's printed instructions and as indicated.

3.2 Field Testing

.1 Comply with the requirements specified in Section 01 65 00 and as specified herein.

.2 Field testing will not be conducted without a procedure with no exceptions noted, calibration certificates for all testing equipment for checklist.

.3 After installation of equipment, and after inspection, operation, testing and adjustment have been completed by the manufacturer’s field service technician, conduct a dry running test and a performance test for each unit in presence of the Contract Administrator to determine its ability to deliver its rated capacity under specified conditions.

.1 Repeat tests until specified results are obtained.

.4 Make all adjustments necessary to place equipment in specified working order at time of above tests.

.5 Remove all replace equipment at no additional cost to the City with equipment that will meet all requirements specified and indicated if unable to demonstrate to the satisfaction of the Contract Administrator that equipment will perform the service specified, indicated and as submitted.

.6 The supplier's representative shall furnish to the City, through the Contract Administrator, a written report certifying that the equipment has been properly installed and lubricated, is in accurate alignment, is free from any undue stress imposed by connecting piping or anchorage, and has been operated under full load conditions and that it operates satisfactorily.

3.3 Field Touch-Up Painting

.1 After installation and acceptance testing by the Contract Administrator, apply touch-up paint to all scratched, abraided and damaged shop painted surfaces. Coating type and color shall match shop painting.

3.4 Contract Closeout

.1 Provide in accordance with Section 01 78 00.

END OF SECTION

OVERHEAD AND MONORAIL TROLLEYS

1. GENERAL

1.1 Scope

.1 Supply and install three (3) complete 1000 kg capacity electrically controlled under running monorail hoist system in the basement area.

.2 Supply and install one (1) complete 3000 kg capacity electrically controlled under running curved monorail hoist system over the dewatering systems on the 2nd floor.

.3 Any other requirements not set forth in these specifications, but necessary for the safe and reliable operation of the equipment, shall be included.

.4 Contractor and crane supplier will furnish on this order:

.1 All material necessary for complete installation of the above-mentioned monorail cranes including runway beams, hangers and clamps.

.2 Complete controls.

.3 Equipment operating instructions.

.4 Drawings and parts lists as specified.

.5 Contractor and crane supplier will furnish the materials and labour for the following:

.1 Complete erection.

.2 Steel runway beams.

.3 Electric power service.

1.2 References, Codes and Standards

.1 The complete system, including the installation, must conform to the applicable requirements of the latest edition of the following:

.1 CSA B167 – Overhead travelling cranes – Design, inspection, testing, maintenance, and safe operation.

.2 ASME Standard B30.16 Overhead Hoists – Underslung.

.3 ASME Standard B30.17 Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist).

.4 ASME Standard B30.10 Hooks.

.5 HST-4M. Performance Standard for Overhead Electric Wire Rope Hoists.

.6 Occupational Safety and Health Administration (OSHA) – Specification 1910.179: Overhead and Gantry Cranes OSHA and Provincial requirements.

.7 Hoist Manufacturers Institute (HMI).

1.3 Submittals

.1 Submit product brochures.

.2 Submit Shop Drawings including full product specifications, performance, and regular maintenance schedules.

.1 Manufacturer's name and catalogue number of any equipment to be furnished not manufactured by vendor.

.2 Any exception or difference of any equipment to be furnished from that specified and reason for the substitution.

.3 Name and address of manufacturer's representative nearest the project site maintaining 24-hour service facilities and complete stock of spare parts.

.4 Supply spare parts as required for one (1) year's maintenance.

.3 Installation, operation, maintenance and lubrication manuals.

1.4 Qualifications

.1 Supplier, and Installing Contractor, and its personnel shall have a minimum five (5) years of demonstrated experience in the related field of design, fabrication, installation, testing and commissioning of this type of equipment.

.2 Acceptable Suppliers:

.1 Century Cranes.

.2 Kone Cranes.

.3 Acculift.

.4 Pydee Engineering.

.5 Or, approved equal in accordance with B7.

1.5 Quality Assurance

.1 Products shall be from a manufacturer that has been regularly engaged in the design and manufacture of the product for over ten (10) years, with a continuous representation for sales and service in the province of Manitoba for at least five (5) years.

1.6 Design Requirements

.1 Design hoists/cranes systems in accordance with the applicable standards and codes.

.2 The equipment will be operated in ambient temperatures ranging from 5°C to 30°C.

.3 Design hoist/crane systems to be capable of lifting its full rated capacity at any location along the crane bridge, and runway beam.

.4 Hoist/crane systems shall be designed to fit within the space allocated on the Drawings.

.5 Cranes shall remain operational under the following conditions:

.1 Building sway under wind loads: H/400 (H: height of building).

.2 Deflection of building roof structure under live loads: L/360 (L: span).

.3 Vertical deflection of monorail beams under crane loads: L/600 (L: span).

.4 Lateral deflection of monorail runway beams under lifting loads: L/600 (L: span).

.6 Hoist shall be capable of lifting its full rated capacity from the floor level to the clear hook height.

.7 Electrical classification: CSA/cUL rated for installation in Category 1 wet location and Category 2 Corrosive location.

.8 Electrical power characteristics: Power for operating the equipment will be supplied by a 575 V, 3 Phase, 60 hertz circuit.

.9 Type of Control:

.1 Pendant mounted to wall.

.2 Pendant shall be mounted 1.2 m above the floor.

.10 Size of monorail beams shall be specified and supplied by crane supplier.

2. PRODUCTS

2.1 Power Driven Trolleys

.1 Four (4) required.

.2 Underslung, four wheel.

.3 Geared, power operated drive, electric break, shock free on starting and stopping.

.4 Suspension systems to match hoists:

.1 Regular Hook Suspension Type:

.1 Three (3) required: WLL: 1,000 kg.

.2 One (1) required: WLL: 3,000 kg.

.5 Adjustable width – to suit monorail beams.

.6 Steel universal tread flanged hardened wheels with permanently lubricated shielded ball bearings.

.7 Drop stops in event of wheel failure.

.8 Steel side plates and connector pin.

.9 Hoist suspension plate for hook mounted hoist.

.10 Acceptable product: CM or approved equivalent.

2.2 Powered Hoists: Four (4) Required

.1 Top hook mount:

.1 Three (3) units: WLL: 1,000 kg.

.2 One (1) unit: WLL: 3,000 kg.

.2 A low head room hoisting machine of proper capacity shall be mounted on the trolley. It shall consist of a motor, gear reducer, hoist drum, sheaves, load block, hook, and hoisting rope. An electric brake shall be supplied on the hoist.

.3 The motor shall be designed specifically for hoisting duty. The electric brake shall be of suitable size to promptly stop the motor rotation in either direction, and hold the load.

.4 Precision cut, full depth teeth, heat-treated forged steel gears shall be used in the gear reducer. These gears shall be provided with oil bath lubrication and enclosed in a drip proof case.

.5 The hoist drum and sheaves shall be of large diameter to permit maximum rope life. The drum diameter shall be at least 20 times the rope diameter and shall be grooved to provide for the entire lift without overlapping the rope. The drum flanges shall be guarded so that the rope cannot wedge between the drum and the hoist frame.

.6 A paddle or weight-operated type upper final limit switch shall be provided to protect against hoisting beyond safe limits of travel. This switch shall be connected to open a main line contactor. The switch system must be designed in such a manner that the switch operator mechanism cannot be over travelled and allow the switch to become inoperative.

.7 A loading limit control device shall be provided to prevent over stressing the system. This device shall de-energize the hoist motor and immobilize the up circuit when an over capacity lift is attempted. This switch must be set to overcome dynamic loading conditions but not exceed 125% rated capacity.

.8 Geared upper and lower limit switches shall be furnished to restrict motion beyond the normal operating travel. These switch contacts shall be connected in the respective motor control circuits.

.9 The hoisting rope shall be improved plow steel, of suitable diameter, with a factor of safety of at least five (5). Connection to the drum shall be made adequately and shall be easily detachable for replacement.

.10 Lift:

.1 Basement hoist over sump pit: 5.5 m.

.2 Basement hoists over pumps: 3. 5 m.

.3 Dewatering hoist: 1 2 m.

.11 Acceptable Product: CM, or approved equivalent in accordance with B7.

2.3 Motors

.1 All motors shall be totally enclosed fan cooled (TEFC) type. They shall be 575 V, 3 phases, and rated for ten (10) minutes continuous operation under full load with a temperature rise not to exceed 20°C above an ambient temperature of 30°C.

2.4 Control Station

.1 A pendant type push-button station shall be provided to control the motions of trolley, and hoist for each hoist system in the basement area. This station shall consist of buttons having the capability to control motion and speed in vertical and horizontal directions.

.2 Two pendant type push-button stations shall be provided to control the motions of trolley, and hoist for hoist system over the dewatering area. One push-button station on the main floor and 2nd one on the second floor. Each station shall consist of buttons having the capability to control motion and speed in vertical and horizontal directions.

.3 The push-button station shall be mounted on wall to a position 1.2 m above the floor level.

2.5 Hoist Control

.1 Speed control shall be provided for all travel and hoisting motions as outlined in Paragraph 2.4 of these Specifications.

.2 All single motions shall be controlled by VFD, reversing type motor starters provides variable speed for the hoists and trolleys.

.3 Fuse or circuit breaker protection shall be furnished for each individual motor.

.4 Forward and reverse motor contactors must be interlocked mechanically and electrically to prevent motor damage if the operator pushes the direction buttons simultaneously.

2.6 Electrical Wiring

.1 The complete electrical installation shall be made in accordance with the National Electric Code requirements and the conditions outlined in this specification.

.2 All electrical equipment shall be mounted in NEMA 4x enclosures.

.3 A grounding system shall be furnished to effectively maintain the enclosures of all electrical equipment such as motors, brakes, starters, push button stations, boxes, etc., at zero

potential. Rigid conduit will provide adequate grounding continuity between enclosures when installed as noted above.

2.7 Runway and Structure

.1 The runways shall consist of standard structural steel shapes, included as part of the pre-engineered building structure installations.

2.8 Painting

.1 All surfaces of the structural parts shall be cleaned, primed and painted.

.2 Clean metal surfaces shall be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements. Remove traces of blast products from surfaces, pockets and corners to be painted by brushing with clean brushes.

.3 Epoxy paint on all monorail/girder beam surfaces.

.4 Finish color shall be safety yellow.

.5 Apply rust preventing compound on machined surfaces.

.6 After completion of installation, thoroughly clean and touch-up the paint work as required.

2.9 Labelling

.1 Provide crane/hoist systems with permanent capacity labels as follows:

.1 Rated capacity in kilograms.

.2 Marked on each side of the monorail/runner beam.

.2 Hook block permanently marked with system capacity.

.3 Place the rated capacity labels on crane, hoist and load blocks at height and location easily read from floor level and loading position.

.4 A corrosion-resistant nameplate shall be fixed to the monorail, and trolley/hoist assembly with the following information.

.1 Name of manufacturer.

.2 Manufacture’s model number and serial number.

.3 Capacity in Kilograms.

.4 Date of manufacture (month and year).

3. EXECUTION

3.1 Installation

.1 Install crane and hoist systems in accordance with Drawings and Specifications meeting the requirements of all applicable codes, standards, specifications and regulations.

.2 Do not modify crane or hoist components in any manner without advance, written approval by manufacturer.

.3 Provide all necessary material, labour, tools and equipment for the installation.

.4 Ensure that installation is carried out within the tolerances specified in this Section, and applicable codes and standards.

.5 Complete all necessary electrical connections to building connection point.

.6 Supply and install supports, hangers, etc. required to support electrical services from building connection point to crane/hoist system.

.7 Upon completion of installation, touch up and restore to new condition, damaged or defaced factory finished surfaces.

.8 Remove protective coverings and clean exposed surfaces after completion.

.9 Install the main disconnect and control panel for the crane/hoist at an accessible location.

.10 All hoist equipment shall be installed in accordance with manufacturer's instructions and recommendations.

.11 Bolted connections shall be in accordance with torque tightening procedures specified in.

.12 AISC Manual, Part 5.

3.2 Testing, Commissioning, Certification and Training

.1 All crane and hoisting equipment shall be operated through a complete lift and lowering cycle and through a complete travel of the bridge and trolley to determine the following:

.1 The equipment shall operate smoothly and safely.

.2 All tests shall be carried out with the crane and hoist systems loaded at 125% of capacity.

.3 Provide all necessary material, labour, tools and equipment required for all testing and commissioning.

.4 Supplier shall provide the test weight loads.

.1 Test weights shall be of minimal size and clearly labelled.

.5 Any defects shall be corrected by the Supplier without any expense to the Contract Administrator.

.6 Hook Block Tests:

.1 Establish a permanent throat base reference dimension before proof load testing, by making two (2) trammel point marks on opposite sides of the hook throat.

.7 Crane and Hoist Tests:

.1 Test the cranes and hoists in accordance with applicable standards.

.8 Hook Tests:

.1 Inspect all hooks for throat spread after completion of the crane load tests. Re-measure the distance between trammel points.

.2 An increase of 1% or more of the throat dimension based on the hook throat opening will constitute failure of this inspection. Replace hooks failing to pass the inspection and retest at Construction Contractor's expense.

3.3 Training and Demonstration

.1 Upon successful completion of testing and commissioning of crane/hoist system, after the delivery of all documentation (manuals, drawings, certificates, etc.) and prior to issuance of Certificate of Completion, carry out equipment and system demonstration and training.

.2 Demonstrate operations and maintenance of equipment and systems and provide training to City's operations and maintenance personnel.

.3 Provide certified personnel to demonstrate operation of crane/hoist system.

.4 Provide Contract Administrator a minimum of seven (7) days advance notice in writing of demonstration.

.5 Prior to demonstration, submit project record documents and operating and maintenance manuals to the Contract Administrator.

.6 Instruct maintenance personnel (one (1) hour minimum allowance) in basic maintenance and use of the crane/hoist system.

3.4 Warranty

.1 Vendor shall guarantee materials and workmanship of equipment installed under these specifications for a period of two (2) years after installation.

END OF SECTION

STEEL PLATFORM TRUCK WEIGH SCALES EQUIPMENT AND COMPONENT NUMBERS

1. GENERAL

1.1 Scope

.1 Supply and install two (2) steel platform truck weigh scales in the Scum Dewatering Building.

1.2 References

.1 The following is a list of standards which may be referenced in this Section:

.1 American Society for Testing and Materials (ASTM): A36/A36M, Standard Specification for Carbon Structural Steel.

.2 American Welding Society (AWS): D1.1, Structural Welding Code.

.3 International Electrotechnical Commission (ANSI/IEC): 60529, Degrees of Protection Provided by Enclosures (IP Code).

.4 International Organization of Legal Metrology (OIML): R 60, Metrological Regulation for Load Cells.

.5 National Electrical Manufacturers Association (NEMA): 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

.6 National Institute of Standards and Technology (NIST): Handbook 44, Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices.

.7 National Type Evaluation Program (NTEP).

.8 Society for Protective Coatings (SSPC).

.9 2010 National Building Code of Canada, with 2011 Manitoba Amendments (NBC).

1.3 Submittals

.1 Shop Drawings:

.1 Make and model of each equipment assembly.

.2 General arrangement drawings including dimensions, weight, size and location of connections to other work, and anchorage requirements.

.3 Manufacturer’s catalog information, descriptive literature, specifications, and identification of materials of construction.

.4 Details of weigh scale modules and load cells.

.5 Control panel drawings showing construction, dimensions, placement of operator interface devices, internal layout, and external interfaces.

.6 Power and control wiring diagrams, including terminal numbers.

.7 Functional description of internal and external instrumentation and controls to be supplied including list of parameters monitored, controlled, or alarmed.

.2 Quality Control Submittals:

.1 Special shipping, storage and protection, and handling instructions.

.2 Manufacturer's printed installation instructions.

.3 Routine maintenance requirements prior to system start-up.

.4 Manufacturer's Certificate of Proper Installation in accordance with Section 01 65 00, Contractor Field Services.

.5 Functional and Performance Test Reports.

.6 Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.

.7 NTEP Certification of Conformance.

.8 Submit written certification from Professional Engineer licensed in Province of Manitoba stating that support systems, anchorage, and equipment have been designed according to requirements of NBC for post-disaster structures, at time of Shop Drawing submittals.

1.4 Extra Materials

.1 Furnish, tag, and box for shipment and storage the following spare parts and special tools:

Item	Quantity
Load cells	Two (2)
Load cell cables	Two (2)
Special tools required to maintain or dismantle equipment	One (1) complete set

.2 Delivery: In accordance with Section 01 61 00, Common Product Requirements.

2. PRODUCTS

2.1 General

.1 Design equipment, anchorage, and support systems for vertical and lateral loading in accordance with NBC.

2.2 Manufacturers

.1 Materials, equipment, and accessories specified in this section shall be products of:

.1 Mettler-Toledo, Inc.; Model VTS231 or approved equal.

2.3 Conditions of Service

.1 Equipment shall be suitable for the following conditions of service:

	WE-G2331, WE-G2341
Application	Standard roll-off type containers for handling wastewater grit and screenings
Location	Indoors
Ambient Temperature (degrees C)	5 to 40
Humidity (%)	Up to 100
Other	Exposed to frequent wash down with plant effluent water

2.4 Design Requirements

.1 Equipment shall be designed for the following requirements:

	WE-G2331, WE-G2341
Minimum Gross Weighing Capacity (kg)	90,000
Minimum Concentrated Load Capacity (kg)	45,000
Overall Scale Length (m)	7.1
Scale Width (m)	3.3
Deck Material	Steel

2.5 Equipment Description

.1 Fully electronic, steel deck truck scale generally consisting of scale modules, load cells, load.

.2 Cell cables, base plates, anchor bolts, digital scale instrument, and all appurtenances required for a complete operating system.

.3 General:

.1 Flat top design without any side rail support beams.

.2 Conforming to NIST Handbook 44.

.3 Maximum depth profile of 432 mm from top of scale to top of foundation at load cell bearing points.

.4 Suitable for installation on concrete pit foundation as shown on Drawings.

.5 Capable of withstanding, without damage, horizontal and vertical forces generated by standard roll-off containers as they are pushed onto and pulled off of scale by haulage truck.

.4 Scale Modules:

.1 Fabricated from steel plate and shapes, ASTM A36/A36M, with longitudinal members continuously welded.

.1 Orthotropic rib design.

.2 All welding shall comply with AWS D1.1 and shall be performed by welders certified to AWS D1.1.

.3 All enclosed chambers of scale structure shall be hermetically sealed to prevent internal corrosion.

.4 Designed to allow access to load cell cables, base plates, and foundation anchor bolts from top of scale platform.

.5 Provide minimum of two (2) access openings with covers to allow operator to access underside of scale.

.6 No bolted connections between load cell and scale modules.

.7 Complete with steel wear plates and guide rails continuously welded to scale deck to resist abrasion from container rollers, protect scale elements from forces generated by rolling action of container rollers, and to guide container into position on scale.

.8 Coordinate dimensions and positioning of wear plates and guide rails with Contract Administrator prior to fabrication.

.5 Load Cells:

.1 Digital type with integral microprocessor and analog-to-digital converter located within load cell housing.

.2 Certified by NTEP and conforming to NIST Handbook 44.

.3 Performance Requirements:

.1 Load Capacity (each): 49,895 kg minimum.

.2 Ultimate Overload Rating: 300%.

.3 Accuracy Class: Class III L in accordance with NIST Handbook 44.

.4 Minimum Verification Interval (Vmin): 2.27 kg maximum.

.5 Hysteresis: plus or minus 0.025% of full scale.

.6 Non-Linearity: plus or minus 0.015% of full scale.

.7 Creep (30 minutes): plus or minus 0.017% of applied load.

.4 Fabricated from stainless steel, hermetically sealed, and rated NEMA 6P and ANSI/IEC IP68 and IP69K.

.5 Designed and constructed to perform as rocker pin with no fixed mechanical connections to scale module or base plate.

.6 Shall not require check rods, flexures, chain links, or similar devices for stabilization.

.7 Integral transient voltage surge suppressors with self-resetting thermal breakers to protect load cell components from voltage and current surges.

.8 Neoprene rubber boot to prevent debris from contaminating lower bearing surface.

.9 Integral, hermetically sealed, positively locking quick connector for connection of load cell cable.

.10 Designed to permit load cell cable to be replaced without requiring splicing of cable, replacement of load cell, or recalibration of scale.

.11 Mettler-Toledo Powercell PDX or approved equal in accordance with B7.

.6 Load Cell Cables: Stainless steel sheathed and continuous from load cells to scale instrument with no splices or junction boxes.

.7 Base Plates: Fabricated from Type 304 or 316 stainless steel.

2.6 Scale Instrument

.1 Provide scale instrument for each weigh scale with following features:

.1 Stainless steel NEMA 4X enclosure, UL/cUL listed, and suitable for wall mounting.

.2 Graphic display screen showing weight, units, time and date, as a minimum.

.3 Keypad for navigating screens and menus and for entering configuration parameters.

.4 External Interfaces: One Profibus communication port.

2.7 Appurtenances

.1 Lifting Lugs: Provide suitably attached for all equipment assemblies and components weighing over 45 kg.

.2 Equipment Anchor Bolts: Type 316 stainless steel, sized by equipment manufacturer, and as specified in Section 05 50 00, Metal Fabrications.

.3 Equipment Identification Plates: In accordance with Section 10 14 13 - Identification.

2.8 Factory Finishing

.1 Prepare, prime, and finish coat in accordance with manufacturer’s standard high-build epoxy coating system.

2.9 Source Quality Control

.1 Factory Functional Test: Perform manufacturer’s standard production tests.

3. EXECUTION

3.1 Equipment Installation

.1 Install in accordance with manufacturer’s printed instructions.

3.2 Field Quality Control

.1 Functional Test:

.1 Conduct on each unit.

.2 Test for continuous three (3) hour period.

3.3 Manufacturer's Services

.1 Manufacturer's Representative: Present at Site or classroom designated by the City for minimum person-days listed below, travel time excluded:

.1 One (1) person-day for installation assistance and inspection.

.2 One (1) person-day for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.

.3 One (1) person-day for pre-start-up classroom or Site training.

.4 One (1) person-day for facility start-up.

.5 One (1) person-day for post-start-up training of the City's personnel. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by the City and Contract Administrator.

.2 See Section 01 79 00 – Demonstration and Training and Section 01 91 31 – Commissioning Plan.

END OF SECTION

1. GENERAL

1.1 Description

.1 This Section defines the general requirements for the supply, installation, and commissioning of all pumps required for this Project.

.2 Contractor to coordinate for all process mechanical equipment power requirements and revisions to electrical distribution system. Acceptable voltages for equipment are 600 V/208 V/120 V.

1.2 Definitions

.1 The terms in the Specification generally comply with the definitions of the Hydraulic Institute.

.2 Definitions:

.1 Efficiency: Pump efficiency shall be calculated as the delivered hydraulic power divided by the electrical power at the inlet box of the pump. It shall take full account of mechanical and electrical losses.

.2 Performance Curve: The performance curve is a graph of the flow delivered (L/s, x-axis) in relation to the discharge head (m, y-axis). It generally denotes efficiencies as isopleths and may include NPSH requirements as a function of the flow.

.3 Best Efficiency Point (BEP): The BEP is the point in the pump performance curve where the pump operates at its highest efficiency.

.4 Rating Point: The pump rating point is the combination of discharge head and flow which the pump must satisfy. It typically is determined on the basis of all duty pumps (one or more, depending on the service) operating simultaneously against the worst system conditions (typically maximum headloss, minimum suction head, maximum discharge head, etc.). This condition is listed in the detailed pump specification and must be satisfied by the pump supplied.

.5 Low Head Point: The low head point is the combination of head and flow which corresponds to the least head the pump might operate against. It is determined on the basis of only one duty pump operating against the system conditions which would produce the least discharge pressure (typically minimum headloss, maximum suction head, minimum discharge head, etc.). The minimum system head is shown or described for each pump. The Manufacturer must ensure that the pump can operate satisfactorily, without cavitation in the pump casing or over-stressing of the motor, at the intersection of the pump curve and the minimum head curve, or low head point.

.6 Low Speed Point: The minimum flow and head conditions against which a variable speed pump is expected to operate.

.7 Net Positive Suction Head (NPSH): The available NPSH is the pressure available at the pump inlet and is a function of site atmospheric pressure, the vapour pressure, the static lift, and suction piping losses. Required NPSH is the pressure required at the pump suction to ensure cavitation due to water column separation does not occur. Required NPSH shall be defined by the pump supplier at the pump inlet connection

whether that be at the casing or at the face of a suction reducer/ elbow supplied as an integral part of the pump.

.8 Minimum Diameter Passing: Solids handling pumps have listed a minimum diameter passing. A sphere of this size must be capable of passing from the pump intake to the discharge.

1.3 Submissions

.1 Shop Drawings: Submit in accordance with Sections 01 33 00 for all pump Shop Drawings, include the following specific details:

.1 Performance curve for the pumping unit(s) superimposed on the system curve for the particular pumping application. Where the system curve is not included in the Specifications, request this information from the Contract Administrator when required. With the performance curve, include efficiency isopleths and NPSHR variation with flow. Where required in the specific pump sections, the performance curve shall be certified in accordance with Hydraulic Standards.

.2 Motor operating data, including motor and insulation ratings, start-up and operating current ratings, operating voltage and amperage tolerances, description of construction complete with illustrative drawings, and any other pertinent information.

.3 List of materials of construction, detailing the component parts of the pump(s), their materials of construction, and reference Specifications for those materials.

.4 Required ancillary services including, but not limited to electrical, seal water, and drains. The sizes, ratings, and any other pertinent information related to these services.

.5 Installation instructions indicating assembly and mounting requirements, alignment and assembly tolerances, and points of connection for ancillary services (electrical, seal water, drains, etc.).

.6 Start-up instructions including lubricant requirements, electrical requirements, etc.

.2 Operating and Maintenance (O&M) Data: Provide for incorporation in O&M manual. Include the following:

.1 Complete description of operation.

.2 General arrangement and detailed Drawings.

.3 Wiring diagrams for power and control schematics.

.4 Parts catalogues with complete list of repair and replacement parts with Section Drawings, illustrating the connection and the parts Manufacturer's identifying numbers.

1.4 Delivery and Storage

.1 Ship pre-assembled to the degree that is possible. Inform installer of any Site assembly requirements.

.2 Securely fasten heavy wood blanks to the pump flanges. Use blanks that are larger diameter than the flange. Protect machined surfaces against rusting. Protect threaded connections with threaded plugs or caps. Protect open, plain pipe ends with caps.

.3 Where pumps are to be stored on Site more than one (1) week, instruct Site staff of specific requirements to ensure there is no uneven wear or distortion of pump component parts.

.4 Identify any special storage requirements.

1.5 Coordination

.1 Coordinate with other Divisions to ensure there are no conflicts in the Work.

2. PRODUCTS

2.1 Pump Performance Requirements

.1 Provide pumps that are suitable for continuous duty.

.2 Select impellers for fixed speed pumps that permit operation at efficiency within 5% of the efficiency at the BEP.

.3 For variable speed pumps, select pump speed and impeller diameter which allow operation from the Rating Point to the Low Speed Point at efficiencies within 10% of efficiency at the BEP.

.4 Ensure that motors are sufficiency sized to drive pumps at a maximum speed when the head is as defined for the low head point.

.5 Provide pumps capable of operating at 30% of the flow at the rated capacity with good efficiency without exceeding the motor horsepower, and capable of operating at any point on its characteristic curve, to where that curve intersects the low head point, without exceeding motor power rating.

.6 Provide for dry run protection.

.7 Provide for seal water installation as required.

2.2 Pressure Sensing

.1 Supply a means of measuring inlet and outlet pressure with each pump, except as noted.

.2 For submersible pumps, provide only one gauge for mounting on the discharge of the pump on a weldolet installed outside of, but within 2 m of, the wet well.

.3 For positive displacement pumps (diaphragm, piston, etc.), provide full pipe diameter annular ring pressure sensor for both the suction and discharge, complete with gauges and connections for instrumentation devices.

.4 Gauges:

.1 Supply gauges that are 75 mm diameter, 6.35 mm bottom connection, complete with shut off cock with stainless steel movement and Bourdon tube.

.2 Use dual face (kPa, psi) metric units of measurement (kPa or Pa), clearly indicated on the face of the gauge.

.3 Calibrate the gauges to read pressure ranges approximately as follows:

	Actual Pressure	**Gauge Pressure Range**
Suction	-50 kPa to 50 kPa	-50 kPa to 350 kPa
	50 kPa to 200 kPa	0 kPa to 350 kPa
	200 kPa to 700 kPa	0 kPa to 1,000 kPa
Discharge	50 kPa to 350 kPa	0 kPa to 700 kPa
	350 kPa to 700 kPa	0 kPa to 1,000 kPa
	700 kPa to 1,500 kPa	0 kPa to 2,000 kPa

.5 Pressure Sensors:

.1 Provide annular ring, flow through type pressure sensors, with stainless steel body, a sensing element compatible with the corrosive and abrasive nature of the fluid being measured, 25 mm diameter.

.2 Supply annular type pressure sensors with their initial fill of fluid.

2.3 Pump Seals

.1 Provide cartridge type, single mechanical seals, externally mounted.

.2 Provide non-destructive, self-aligning seals of the stationary design which require no wearing sleeve for the shaft.

.3 Material of construction:

Type of Service	**Metal Parts**	**Spring(s)**	**O-Rings**	**Faces**
Potable water or Carbide Chemical	316 or 317 L Stainless Steel	316 or Hastelloy C	Buna-N or Viton	Silicon Carbide on Carbon

2.4 Bearings

.1 For all pumps other than submersible, provide a bearing shield, complete with labyrinth seals, to prevent the ingress of water.

2.5 Protective Guards

.1 Provide a protective guard for all couplings and keys, drive belts, or other exposed rotating devices. As a minimum, conform to the requirements of Section 46 21 00.

2.6 Couplings

.1 For all pumps other than submersible, provide flexible, double disc, spacer type couplings.

.2 Design couplings so that the pump unit can be disassembled without disturbing face piping.

2.7 Shafts

.1 Design shafts to absorb 1.15 times the rated power of the motors required to drive the pumps when the pump is fitted with maximum size impellers.

.2 Use stainless steel shafts, without any allowance for shaft sleeves.

2.8 V-Belt Drives

.1 Do not use V-belt drives unless specified or shown on the Drawings.

.2 In accordance with the requirements of Section 46 21 00.

2.9 Spare Parts

.1 For each centrifugal pump type and size, provide for one (1) spare mechanical seal or packing kit (as applicable) and one (1) set of pump bearings.

.2 For each size of seal water connection, one rotameter.

.3 For each centrifugal pump type and size, provide a single impeller, wear plate, suction ring (if replaceable), one pumps shaft, and nut.

2.10 Factory Performance Testing

.1 Where required for specific pumps, as noted in the sections related to those pumps, factory performance test all pumps.

.2 Conduct factory performance testing in compliance with the Hydraulic Institute Standards.

.3 Inform Contract Administrator at least three (3) weeks prior to the factory testing to allow for his/her attendance.

.4 Certify test results and summarize findings in a short report. Submit report within three (3) weeks of completing factory tests.

.5 Where the pump(s) does not satisfy the specified performance requirements within the tolerances specified by the Hydraulics Institute, redesign, modify, and re-test the pump(s), all at no additional cost.

.6 Do no ship the pump(s) until the test result report has been submitted to the Contract Administrator and it meets Specification requirements.

2.11 Finishes

.1 Factory prime and paint all pumps in accordance with Division 9.

2.12 Manufacturer

.1 Each pump type shall be provided by single manufacturer.

3. EXECUTION

3.1 Installation

.1 Comply with the requirements of Section 43 21 00 and any special requirements listed in the specific Sections related to each pump.

3.2 Testing

.1 Field test all pumps to verify performance.

.2 Factory test all pumps over 3.7 kW.

.3 Provide temporary connections, flow monitoring, pressure monitoring, ammeters, and temporary tankage required for the performance of the tests.

.4 Flow Metering:

.1 Where possible, use fill and draw techniques to determine the amount of flow conveyed during the test period. Ensure that the volumes are sufficient for at least five (5) minutes of pump operation at the flows that are to be tested, other than run-out.

.2 Where permanent flow meters are installed on the downstream piping, they may be used to measure the flow during testing when accepted by the Contract Administrator. Ensure that the permanent flow meters are calibrated to within 5% of the rated flow of the pump to be tested prior to testing.

.3 Temporary metering may be used if accepted by the Contract Administrator. Temporary meters must have an accuracy of plus or minus 5%, at the rated flow of the pump, to be acceptable.

.4 Where other methods are not possible or where directed, use dye testing to determine the flow during the test periods. Dye testing is to be conducted by an agency acceptable to the Contract Administrator. Measured flows during the testing will be certified by a qualified Engineer to be within 5% of the actual flows.

.5 Pressure Monitoring:

.1 Do not use permanent gauges for pressure monitoring during tests. Temporary test gauges can be connected to the permanent gauge taps.

.2 Use gauges with sufficient accuracy to measure anticipated pressures on pump discharges within 2.5%. Where pump suction draws from an open tank or wet well, test gauge must be capable of measuring pressure at pump suction within 1 kPa.

.3 Provide evidence of pressure gauge calibration within three (3) months of conducting tests.

.6 Test pumps at a minimum of three (3) flow conditions, typically corresponding to the rating point flow, 75% of that flow, and 120% of that flow. At each test point, measure flow, pressure, and amperage. In addition, verify run-out conditions.

.7 For variable speed pumps, conduct the tests at two (2) speeds, typically 100% of the design speed and 30% of the design speed.

.8 Field Test Report:

.1 Compile field test results into a report for submittal to the Contract Administrator.

.2 Describe test set-up and measurement devices used to conduct the tests.

.3 For each pump, list the specified performance requirements and field test results. Show field test results (flow, pressure, power draw) superimposed on the performance curve provided with the submission.

.9 Where field tests to not verify compliance with specified performance requirements, investigate cause for non-compliance, undertake remedial Work as required to bring pump into compliance, or replace the pump and all necessary ancillaries, and re-test to prove compliance. All Work required to bring the pump into compliance is the responsibility of the Construction Contractor.

END OF SECTION

PROCESS EQUIPMENT INSTALLATION

1. GENERAL

1.1 Description

.1 Installation, including the supply of anchor bolts, and testing of equipment supplied under other Sections in Division 43.

.2 This Section is to be read in conjunction with the provided process and instrumentation drawings and general arrangement drawings.

1.2 Definitions and Interpretations

.1 Testing: In this Division, testing is defined as the operation of a specific item of equipment under actual or simulated conditions for the purpose of verifying the equipment satisfies its basic design criteria. Testing shall be conducted by the Construction Contractor. All materials, labour, power and equipment required to conduct the tests shall be the Construction Contractor's responsibility. The Manufacturer is to provide technical assistance to the Construction Contractor for the installation, testing, start-up and commissioning of the equipment supplied.

.2 Commissioning: In this Division, commissioning is defined as the operation of equipment systems under actual and/or simulated conditions for the purpose of ensuring the system performs its intended functions. Refer also to Section 01 91 31.

1.3 Submittals

.1 Submit Shop Drawings in accordance with Section 01 33 00.

.2 Provide Operation and Maintenance (O&M) Data for incorporation in the O&M Manual as specified in Sections 01 78 00.

1.4 Coordination

.1 Coordinate with other Divisions to ensure that there is no conflict with the work.

.2 Coordinate for all process mechanical equipment power requirements and revisions to electrical distribution system. Electrical distribution system shall include, but not limited to, equipment dimensions, circuit breakers, cabling, working space, and clearance requirements at no additional cost to the project.

.3 Coordinate all process equipment control and monitoring requirements and revisions to Plant Control System. Plant Control System shall include, but not limited to, cabling, PLC cards and network switches at no additional cost to the project.

1.5 Shipment, Protection and Storage

.1 Ship all equipment skid-mounted and pre-assembled, to the degree which is practicable.

2. PRODUCTS

2.1 Equipment Schedule

.1 Unless indicated otherwise, supply and install all equipment detailed on the equipment Specification sheets or shown on the Drawings.

.2 Determine the extent of equipment to be supplied from the Specifications, list of equipment and materials and Manufacturer's Drawings covering the equipment. Furnish and install all additional materials necessary to complete the installation.

.3 Incorporate all ancillary devices in the installation including those providing for seal water, lubricant supply, process drains, electrical connection, and instrumentation and control requirements.

2.2 Mounting Requirements

.1 Provide all supports, anchorage, and mounting of all equipment in accordance with the Manufacturer's recommendations, the 2015 National Building Code, and industry standard requirements, unless otherwise specified.

.2 Design and provide all elements required to resist the calculated forces described herein or required by the element Manufacturer.

.3 For rotating equipment, where specified, submit design notes and calculations for anchorage, signed and sealed by a Professional Engineer registered in the Province of Manitoba.

3. EXECUTION

3.1 Coordination

.1 Coordinate the Work specified under this Section with the Work of other Sections to produce a complete and workmanlike job.

.2 Coordinate the placement of equipment bases and housekeeping pads with Division 3.

.3 Coordinate the routing of ancillary piping with Division 23.

.4 Coordinate the routing of electrical and control wiring and conduit with Division 26.

3.2 Preparation

.1 Before commencing installation of the Work, inspect and take field measurements and make sure that Work conducted previously in the area is not prejudicial to the proper installation of the Works.

.2 Refer to the equipment Specifications for assistance in determining the form in which equipment is to be shipped and the extent of field assembly required.

.3 Dimensions shown on the Bid Documents for equipment bases, piping connections, etc., are approximate and must be corrected by the Construction Contractor to suit the exact

dimensions of the equipment provided for each application. Arrange any necessary modifications to piping connections, pipework, or other ancillaries at no cost and after acceptance by the Contract Administrator.

.4 Schedule Manufacturer's Representative Site visits. Cooperate in his supervision of the installation and start-up. Follow all reasonable instructions of the Manufacturer's Representative. Should the Construction Contractor require the Manufacturer's Representative to attend for longer or more frequent periods he shall arrange this, at his own expense, with the Manufacturer.

3.3 Installation

.1 Install all equipment specified in other Sections, detailed on the equipment Specification sheets, or shown on the Drawings.

.2 Dimensions shown on the Construction Contract Documents for equipment bases, piping connections, etc., are approximate. Correct to suit the exact dimensions of the equipment provided for each application. Arrange any necessary modifications to piping connections, pipework, or other ancillaries after acceptance by the Contract Administrator.

.3 Supply and install all necessary shims, gaskets, etc., required to complete the installation.

.4 Provide for the use of all necessary lifting and loading equipment and all tools required to complete the installation.

.5 Comply with the specific requirements for installation noted in other Sections of this Specification and with the instructions of the Manufacturer. Where there is a conflict in these requirements, identify the conflict to the Contract Administrator and proceed as directed.

3.4 Equipment Bases and Anchorage

.1 Equipment will be mounted on housekeeping pads that are a minimum of 100 mm to 200 mm high.

.2 For rotating equipment of 7.5 kW or greater and for equipment requiring structural anchoring, set anchor bolts in advance. Where required, set anchor bolts in sleeves to permit minor adjustment during installation. Use machine base templates where shown.

.3 Prepare grout as specified in Section 03 30 00 and provide full contact with the equipment bases unless otherwise recommended by the equipment Manufacturer and accepted by the Contract Administrator. Neatly bevel, form or trim the grout.

.4 Where equipment is supplied with a plate steel base, provide access holes in the top of the plate and use a pour grade, non-shrink, non-metallic grout as specified in the structural concrete Specifications to fill the entire void under the base.

.5 Fixings to concrete structures shall be by adhesive anchors suitably designed for the application.

3.5 Alignment

.1 Set and align all rotating equipment in accordance with the more stringent requirements of either the Manufacturer's requirements or the following:

.1 Level base, use machinists level on all machined bases.

.2 Align couplings to satisfy the following criteria:

Coupling Speed	**Allowable Angular Misalignment**	**Allowable Parallel Misalignment**
Under 100 rpm, below 50 hp	4'00"	0.25 mm
Under 100 rpm, 50 hp and over	3'00"	0.12 mm
100 to 600 rpm	2'00"	0.12 mm
600 to 1,800 rpm	1'00"	0.10 mm
1,800 to 3,600 rpm	0'35"	0.05 mm

.3 Check for soft foot, maximum permissible 0.002 mm.

.4 Where equipment undergoes a substantial differential temperature rise (30°C between driver and driven unit), provide precision benchmarks in foundation and on equipment and perform alignment at operating temperatures.

.5 Demonstrate to the Contract Administrator and Manufacturer's Representative the final alignment.

3.6 Lubricants

.1 Extend any inaccessible lubrication points and lubricant drains to convenient locations.

.2 Remove storage lubricant and provide the initial fill of new lubricants for the equipment. Lubricant grade to be as recommended by the Manufacturer.

.3 Provide a Lubrication Schedule for all process equipment. Include the following:

.1 Equipment name and number.

.2 Date(s) of lubrication.

.3 Lubricant type installed.

.4 Frequency of lubrication.

3.7 Vibration Survey

.1 Conduct a vibration survey under normal operating conditions for all equipment exceeding 37 kW, and for smaller units where specified.

.2 Use a calibrated vibration sensor, accepted by the Contract Administrator and capable of measuring unfiltered vibration velocities and peak-to-peak amplitudes. Select a sensor capable of measuring velocities at a precision of 0.1 mm/s and an accuracy of plus or minus 0.2 mm/s.

.3 Monitor vibration in all three (3) dimensions at the head and tail end of both the driver and driven units, at intermediate bearing points, and at other critical locations which may be identified by the Contract Administrator.

.4 Record the vibration velocities for each item of rotating equipment and submit a report to the Contract Administrator detailing the findings. Include a description of the measuring equipment, identification of equipment on which vibration monitoring was completed, description of conditions under which the test was conducted, and a listing of all of the collected data.

.5 Unless specified otherwise, use unfiltered velocities as the vibration criteria. Unfiltered velocities less than 5 mm/s shall be considered acceptable. Undertake corrective action where unfiltered velocities exceed 5 mm/s.

3.8 Noise Survey

.1 Conduct a noise survey for all equipment over 37 kW, and for smaller units where specified.

.2 Use a calibrated noise meter, accepted by the Contract Administrator, and capable of measuring noise in the A Scale at a precision of 0.5 dBA and an accuracy of 1 dBA.

.3 Measure noise levels at an elevation similar to the major noise emitter from the equipment (bearing housing, muffler, etc.) and at a horizontal distance of 1 m.

.4 Record the noise levels for each item of equipment and submit a report to the Contract Administrator detailing the findings. Include a description of the measuring equipment, identification of equipment on which noise level monitoring was completed, description of conditions under which the test was conducted, and a listing of all of the collected data.

.5 Equipment is to operate at a noise level of less than 80 dBA, when measured in free field at 1 m. Noise requirements may be more stringent in areas where more than one (1) item of process equipment is intended to operate concurrently. Specific requirements for equipment that differ from 80 dBA are listed in the Sections related to those items of equipment.

.6 Noise abatement features (acoustic panels, acoustic insulation, etc.) are specified in other Sections.

.7 Where a noise level of 80 dBA is not achievable, post noise level clearly on each entryway to the area.

.8 In any process area, recommend whatever measures necessary to maintain a composite noise level below 80 dBA. Where directed by the Contract Administrator, undertake those corrective actions at no cost to the Contract Administrator.

3.9 Quality Assurance Forms

.1 Test all process equipment to ensure the equipment operates in accordance with the basic design criteria listed in the Specification Sections. Complete Form 101, Form 102 and Form 103 that attest to the proper installation and functioning of the equipment.

END OF SECTION

CHEMICAL SUPPLY

1. GENERAL

1.1 Summary

.1 This Section provides a summary of the quantity and properties of the chemicals required for twelve (12) months of scum dewatering equipment operation at average flow.

1.2 Definitions

.1 Supply the process chemicals as specified in this section for twelve (12) months of scum dewatering equipment operation.

1.3 Manufacturers

.1 Cleartech Industries.

.2 Univar.

.3 Avista Technologies.

.4 Kemira Water Solutions Canada Inc.

.5 Or approved equal.

1.4 Shipping Protection and Storage

.1 Ship, protect, and store all chemicals in a heated storage.

2. PRODUCTS

2.1 General

.1 Supplier of the Rotary Press equipment shall recommend the type of the polymer to be supplied.

2.2 Materials

.1 Supply all chemical listed in table below for the Scum Dewatering Plant.

Chemical	Solution Concentration	Unit Size	No. of Units Required
Emulsion Polymer	Minimum 40%	1000 L IBC tote	2

.2 Provide IBC spill pallet for the totes.

.1 Acceptable Product:

.1 Ultra-IBC Spill Pallet Plus by UltraTech International.

.2 Or approved equal.

3. EXECUTION

3.1 Delivery

.1 The chemicals shall be delivered to the NEWPCC with sufficient chemical on-site by Interim Completion to run the dewatering equipment without interruption. The Contractor shall provide the Contract Administrator at least seven (7) working days' notice as to the precise dates of chemicals arrival.

.2 Inspect all containers before storage to ensure containers are properly labeled and not damaged.

END OF SECTION

SUBMERSIBLE PUMPS

1. GENERAL

1.1 Description

.1 This Section specifies the supply, installation, testing and commissioning of submersible pumps. Install the equipment as shown on the Drawings.

1.2 Submittals

.1 Shop Drawings: Submit in accordance with Section 01 33 00 - Submittals and Section 40 05 01 – Common Work, submit the following:

.1 Drawings and Manufacturer's literature indicating layout, assembly details, materials of construction, equipment weights, and any other pertinent information.

.2 Mounting details including anchor bolts designed to withstand lateral forces during installation and operation.

.3 Information for all components of the system including but not necessarily limited to:

.1 Motor data including efficiency rating.

.2 Pump data.

.3 Pump rated capacity.

.4 Catalogue data for all ancillary electrical components. Power and control wiring diagrams, including terminals and numbers.

.5 Installation instructions indicating assembly and mounting requirements, alignment and assembly tolerances, and points of connection for ancillary services. Include dimensional tolerances.

.6 List of which components and materials will be shipped pre-assembled and a parts list for other components and materials. Indicate the weights and physical dimensions for each part, assembly and package to be shipped.

.4 A copy of this Section indicating conformance or acceptance of each clause. Non-conformance or variation shall be indicated by a cross ('X').

.2 Operation and Maintenance Data: Provide for incorporation in operation and maintenance manual as specified in Section 01 33 00 - Submittal Procedures and Section 01 78 00 - Closeout Submittals. Include complete description of operation together with general arrangement and detailed drawings, wiring diagrams for power and control schematics, parts catalogues with complete list of repair and replacement parts with section drawings illustrating the connections and identifying numbers.

1.3 Coordination

.1 Refer to Section 43 21 00 - Process Equipment Installation for general coordination requirements.

.2 Coordinate with other Divisions to ensure there are no conflicts in the installation of the equipment.

.3 Coordinate all process equipment power requirements and revisions to electrical distribution system. Electrical distribution system shall include, but not limited to, equipment dimensions, circuit breakers, cabling, working space, and clearance requirements at no additional cost to the project.

.4 Coordinate all process equipment control and monitoring requirements and revisions to Plant Control System. Plant Control System shall include, but not limited to, cabling, PLC cards and network switches at no additional cost to the project.

1.4 Shipment, Protection and Storage

.1 Ship pre-assembled to the degree possible. Provide information on Site assembly requirements.

.2 Identify special storage requirements.

.3 Provide on-site storage as per Manufacturer's recommendations to prevent damage, undue stress or weathering.

1.5 Design and Regulatory Requirements

.1 Refer to Section 43 21 00 - Process Equipment Installation for general coordination requirements.

.2 All equipment and related components are to be CSA approved.

1.6 Quality Assurance

.1 Supply the equipment covered by this specification as a single package from one Manufacturer, complete with motor and appurtenances. The Manufacturer will be regularly engaged in the production of the equipment for the specified use. The Manufacturer is solely responsible for the proper functioning of the equipment as furnished.

.2 Only those Manufacturers will be considered who regularly engage in the manufacture of the submersible pumps herein specified and who can demonstrate ten (10) installations of this specified design, in actual service for a period of not less than ten (10) years.

1.7 General Design Summary

.1 Provide submersible pumps equipped with bi-metallic switch for over heat protection.

.2 Pump and motor assemblies close coupled integral, wet well submersible type.

.3 Provide 316SS double guide with upper guide bar holder and designed to press tightly against the discharge elbow with metal to metal contact.

.4 Provide 316SS lifting chain, shackle and hook for each pump.

.5 Provide lifting davit.

.6 Provide power cable.

.7 Stainless steel fasteners, bolts, nuts and washers to assemble the unit.

1.8 Identification

.1 For identification purposes, provide a corrosion resistant nameplate securely affixed in a conspicuous place. On the nameplate list equipment model number, serial number, Manufacturer's name and location.

2. PRODUCTS

2.1 Detailed Pump Specification Sheets

.1 Pump data is listed in the detailed specification sheets.

2.2 Design

.1 Select and design submersible pumps specifically for constant duty pumping of raw sewage and be suitable for exposure to wastewater containing grit and other abrasive and fibrous material.

.2 All pumps are to be supplied from a single manufacturer.

2.3 Acceptable Manufacturers

.1 The following manufacturers are listed as Acceptable Manufacturers for the supply of submersible pumps in compliance with the Specifications and Drawings:

.1 KSB.

.2 Flygt.

.3 Grundfos.

.4 Sulzer.

.5 Approved alternative.

.2 Certify that the pump can be returned for warranty maintenance to the factory or a local repair facility at no added cost to the City.

2.4 Lifting Davit

.1 Provide one (1) complete portable lifting davit and accessories. Only one (1) is required for all submersible pumps, size davit for largest pump.

.2 Provide floor socket for each submersible pump, positioned for removal.

2.5 Impeller

.1 Provide a cast iron, dynamically balanced, multi-vane non-clogging impeller, having a long throughlet without acute turns.

.2 The impeller shall be capable of pumping fibrous materials, heavy sludges, and solids as defined by the minimum size passing as listed in the detailed specification sheets.

.3 Firmly affix the impeller directly to the motor shaft through a keyed and bolted connection. Design the connection to minimize solids capture.

2.6 Pump Shaft

.1 Fabricate the shaft of C1035 carbon steel.

.2 Pump and motor shaft shall be one unit. Couplings are not acceptable.

.3 Provide a shaft of sufficient diameter to assure rigid support of the impeller and to transmit loads without slip, vibration, or undue deflection at all operating speeds.

.4 Completely isolate the shaft from the pumped liquid.

2.7 Pump Volute

.1 Cast iron, Class 30, to ASTM A48.

.2 Single piece, non-concentric design.

.3 Fit a stainless steel wear ring to the volute inlet to provide efficient sealing between the volute and the impeller.

2.8 Motors

.1 Motors to conform to the requirements of Division 26 and Section 43 20 10 – Process Pumps – General Requirements. In addition, motors shall conform to the following:

.1 House the motor in an air-filled watertight chamber.

.2 Design the motor for continuous duty, and capable of sustaining twelve (12) starts per hour.

.3 The pump/motor assembly is to be CSA approved as one unit.

.4 Provide motors suitable for speed control from a pulse-width modulated variable frequency controller. Accordingly, motors shall be capable of operating at 10% of their design speed without additional cooling.

.5 Supply motors with three (3) 100 ohm platinum temperature detectors (RTDs) in the stator windings, in accordance with Division 26.

.2 Provide SOWW power cable, with length of 30 m.

2.9 Seals

.1 Provide dual independent pump seals which prevent the pumped liquid from entering the motor cavity.

.2 Approved manufacturers are:

.1 Durametallic.

.2 John Crane.

.3 Five Star.

.4 Chesterton.

.5 Burgmann.

.3 Provide dual independent seals with an oil chamber for the shaft sealing system. Design the oil chamber to accommodate oil expansion due to temperature fluctuations.

.4 Provide seals which are maintenance and adjustment free, and capable of being easily inspected and replaced.

2.10 Bearings

.1 The pump shaft rotates on permanent oil or grease lubricated bearings.

.2 Provide duplex thrust (angular contact), anti-friction type bearings.

.3 Provide bearings with a minimum B-10 bearing life of 80,000 hours.

2.11 Seal Leak and Motor Windings High Temperature Detection

.1 Pumps shall have integral seal leak and motor windings high temperature sensors complete with cable.

.2 Provide the associated controller relay and install in the associated motor starter compartment.

.3 The controller shall have 120 VAC power supply and 10 A output relay.

.4 Sensors and Controller/Relay to match the supplied pumps and shall be provided by the pump supplier.

2.12 Spare Parts

.1 Provide the following spare parts per each size of pump:

.1 One (1) seal set.

.2 One (1) set of motor bearings.

.3 One (1) set of pump bearings.

.2 Provide a list of spare parts which might be required during the initial five (5) years of operation. Provide prices and delivery times for each part.

2.13 Bolts and Nuts

.1 Provide bolts and nuts of type 304 stainless steel dipped in "moly" or anti-seize compound to prevent galling.

.2 Construction Contractor to provide chemical adhesive type anchor bolts type 304 stainless steel.

2.14 Protective Coatings

.1 Shop prime and paint in accordance with Manufacturer’s written recommendations.

.2 Finish coating of motor to be Manufacturer’s standard colour.

.3 Provide system equivalent to Amercoat 384 primecoat and Amercoat 450 HS Urethane finish cost.

3. EXECUTION

3.1 Manufacturer's Representative

.1 Manufacturer's Representative shall be required to attend the site to train staff, and to witness installation and testing to ensure the equipment is installed and operated as intended.

.2 The minimum periods shall be as follows:

.1 Installation and testing: one (1) day.

.2 Staff Training: one (1) day.

3.2 Installation

.1 Verify satisfactory delivery of the equipment by completing Form 100.

.2 Manufacturer’s Representative to instruct the Construction Contractor in the methods and precautions to be followed in the installation of the equipment. Certify the Construction Contractor's understanding by completing Form 101.

.3 Install equipment in accordance with approved Shop Drawings and the Manufacturer's installation instructions.

.4 Ensure the equipment is installed plumb and true, within tolerances specified by the Manufacturer and in accordance with Section 43 21 00 to provide satisfactory service.

.5 Final electrical connections are to be made by the Construction Contractor.

3.3 Installation Witnessing

.1 Manufacturer’s Representative to cooperate with the Construction Contractor to fulfill the requirements for a successful installation as documented by Form 102.

.2 Ensure the equipment is installed as required to provide satisfactory service.

3.4 Performance Testing

.1 Manufacturer to provide written summary of test protocols one (1) month prior to proceeding with the tests.

.2 Construction Contractor and Manufacturer's Representative to ensure the equipment, including all component parts, operates as intended.

.3 Manufacturer's Representative to cooperate with the Construction Contractor to fulfill the requirements for successful testing of the equipment as documented by Form 103.

.4 Devise method to test and prove capacity of the pumps. Submit method to the Contract Administrator for review, a minimum of one month prior to proceeding with the tests.

.5 Events that qualify as unsuccessful and incomplete Performance Testing include, but are not necessarily limited to, the following:

.1 Binding or jamming.

3.5 Commissioning

.1 Construction Contractor and Manufacturer's Representative to be in attendance during commissioning of the process system that includes the equipment specified in this Section to ensure the equipment functions as intended as documented by Form 104. Cooperate with the Commissioning Team in developing the Commissioning Plan for this equipment. Provide assistance as required for system programming, start-up and trouble-shooting.

3.6 Training

.1 Provide the services of a factory-trained Manufacturer's Representative for the purpose of training the City's operation and maintenance staff in the proper operation and maintenance of the equipment as documented by Form T1 and Form T2.

END OF SECTION

EQUIPMENT DATA SHEET

Description:	Filtrate Sump Pump 1 & 2
	P-3501 & P-3502
Number:	2
Design Conditions:	
Liquid:	Filtrate
Liquid temperature:	5-30ºC
Solids content:	0-5%
NPSH Available:	2.0 m
Minimum solids passing:	38 mm
Pump Location	Filtrate Lift Station
Rating Point:	
Rated Flow:	15 L/s
Rated TDH:	24.4 m
Static Head	10.6 m
Construction:	
Flange Rating:	Class 125
Impeller Material:	Grey Cast Iron
Casing Material:	Grey Cast Iron
Driver:	
Drive Type:	Submersible
Motor Type:	Fixed Speed
Phases/Voltage/Frequency:	3-phase/600 V/60 Hz
Motor Speed:	3440 rpm
Minimum Motor Size:	11 HP
Classification:	As per Section 26 05 00 and Drawing sheet number 20-E101 and 20-E102
Accessories:	7 m stainless steel lifting cable
	Thermal and Moisture sensors complete with control unit
	Lifting davit complete assembly (portable) – one common davit for all
	316SS guide rails
	Auto connect discharge seat
	Flush valve
	Float switches x4
Acceptable Manufacturers:	Flygt
	KSB
	Sulzer
	Grundfos
	Or approved equal

END OF SECTION

HORIZONTAL DRY PIT CHOPPER PUMP

1. GENERAL

1.1 Work Included

.1 Supply and supervision of the installation, testing, and commissioning of horizontal, single stage, end suction, centrifugal chopper pumps specifically for municipal applications.

.2 The Work will comprise of a centrifugal chopper pump application (Scum). It is the responsibility of the Construction Contractor to assess and evaluate information provided, including specifications, drawings, design rationale and process control description. The Construction Contractor shall provide appropriate justification (i.e. process calculation) for the selection and configuration.

.3 The horizontal chopper pumps shall be specifically designed to pump waste solids at heavy consistencies without plugging or dewatering of the solids. Materials shall be chopped/macerated and conditioned by the pump as an integral part of the pumping action. The pump must have demonstrated the ability to chop through and pump high concentrations of solids such as plastics, heavy rags, grease and hair balls, wood, paper products and stringy materials without plugging, both in tests and field applications.

1.2 Submittals

.1 Shop Drawings:

.1 Make, model, weight, power, and cross sectional details and colour brochures of each equipment assembly.

.2 Complete catalog information, descriptive literature, Specifications, and identification of materials of construction.

.3 Performance data curves showing head, capacity, horsepower demand, and pump efficiency over the entire operating range of the pump, from shutoff to maximum capacity. Indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the guarantee point.

.4 Detailed Drawings showing the equipment dimensions, size, and locations of connections and weights of associated equipment.

.5 Power and control wiring diagrams, including terminals and numbers.

.6 Complete motor nameplate data, as defined by NEMA, motor Manufacturer, and including any motor modifications.

.7 Factory finish system.

.8 Size, length and spacing of anchor bolts or attachment to the foundations or supports.

.9 External utility requirements air, water, power, etc. for each component.

.10 Control Panel external face layout and inter layout drawings and electrical wiring diagrams.

.2 Quality Control Submittals:

.1 Factory Functional and Performance Test Reports.

.2 Manufacturer's certification of compliance that the factory finish system is identical to the requirements specified herein.

.3 Special shipping, storage and protection, and handling instructions.

.4 Manufacturer's printed installation instructions.

.5 Suggested spare parts list to maintain the equipment in service for a period of five (5) years.

.6 Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.

.7 List special tools, materials, and supplies furnished with equipment for use prior to and during start-up and for future maintenance.

.8 O&M manual: Provide for incorporation in an Operation and Maintenance Manual. Include complete description of operation together with general arrangement and detailed drawings, wiring diagrams for power and control schematics, status information to the plant control system (PCS), parts catalogues with complete list of repair and replacement parts, with section drawings, illustrating the connections and identifying numbers.

1.3 Coordination

.1 Coordinate with other Divisions to ensure there are no conflicts in the work.

.2 Coordinate all process equipment power requirements and revisions to electrical distribution system. Electrical distribution system shall include, but not limited to, equipment dimensions, circuit breakers, cabling, working space, and clearance requirements at no additional cost to the project.

.3 Coordinate all process equipment control and monitoring requirements and revisions to Plant Control System. Plant Control System shall include, but not limited to, cabling, PLC cards and network switches at no additional cost to the project.

2. PRODUCTS

2.1 Detailed Pump Specification Sheets

.1 Specific pumps are listed in the detailed specification sheets.

2.2 Design

.1 Impeller:

.1 Shall be semi-open type with pump out vanes to reduce seal area pressure. Chopping/maceration of materials shall be accomplished by the action of the cupped

and sharpened leading edges of the impeller blades moving across the cutter bar at the intake openings, with a maximum set clearance between the impeller and cutter bar of 0.015-0.025” cold. Impeller shall be cast alloy steel heat treated to minimum Rockwell C 60 and dynamically balanced. The impeller shall be keyed to the shaft and shall have no axial adjustments and no set screws.

.2 Volute Casing and Back Pull-out Plate:

.1 The pump casing shall be of volute design, spiraling outward to the 125 lb. flanged centerline discharge. Back pull-out design shall incorporate jacking bolts for accurate adjustment of impeller-to-cutter bar clearance and shall allow removal of pump components without requiring disconnection of casing from inlet or discharge piping. Casing & backplate shall be ductile cast iron with all water passages to be smooth, and free of blowholes and imperfections for good flow characteristics. A pressure tap shall be included on or near the discharge flange. Backplate shall include a replaceable Rockwell C 60 steel cutter adjustable for 0.005-0.015" clearance to cut against the rotating impeller pumpout vanes for removing fiber and debris.

.3 Cutter Bar Plate:

.1 Shall be recessed into the pump bowl and shall contain at least 2 shear bars extending diametrically across the intake opening to within 0.010-0.020” of the rotating cutter nut tooth, for the purpose of preventing intake opening blockage and wrapping of debris at the shaft area. Chopper pumps utilizing individually mounted shear bars shall not be acceptable. Cutter bar shall be alloy steel heat-treated to minimum Rockwell C 60.

.4 Cutter Nut:

.1 The impeller shall be secured to the shaft using a cutter nut, designed to cut stringy materials and prevent binding using a raised, rotating cutter tooth. The cutter nut shall be cast steel heat treated to minimum Rockwell C 60.

.5 Upper Cutter:

.1 Shall be threaded into the back pull-out adapter plate behind the impeller, designed to cut against the pump-out vanes and the impeller hub, reducing and removing stringy materials from the mechanical seal area. Upper cutter shall be cast steel heat treated to minimum Rockwell C 60. The upper cutter teeth are positioned as closely as possible to the center of shaft rotation to minimize cutting torque and nuisance motor tripping. The ratio of upper cutter cutting diameter to shaft diameter in the upper cutter area of the pump shall be 3.0 or less.

.6 Pump Shafting:

.1 Shall be heat treated alloy steel.

.7 Bearings:

.1 Shall be oil-bath lubricated with ISO Gr. 100 turbine oil. Shaft thrust in both directions shall be taken up by two (2) back-to-back mounted single-row angular contact ball bearings. Two (2) adjacently mounted single-row radial bearings shall also be provided. B10 bearing life shall be minimum 100,000 hours.

.8 Bearing Housing:

.1 Shall be ductile cast iron and machined with piloted bearing fits for concentricity of all components. Bearing housing shall include a side-mounted site glass. Viton® double lip seals riding on stainless steel shaft sleeves are to provide sealing at each end of the bearing housing. Thrust bearings are mounted in an adjustable cartridge to allow external upper cutter adjustment.

.9 Stuffing Box:

.1 Shall be ductile cast iron. The stuffing box shall be designed to accommodate the mechanical seal. Mechanical seal with no seal water flush as described below does not require stuffing box.

.10 Seal:

.1 Mechanical seal with throttle bushing and water fitting for seal water flush. The seal shaft sleeve shall be AISI 316 SS. Mechanical seal materials shall be either 316 stainless steel or Alloy 20 with silicon carbide or tungsten carbide faces. Seal shall be positively driven by set-screws. Elastomers shall be of Buna N, and stationary seal member shall be of the cup-mounted type to ensure cushioning of face material from mechanical shock. Contractor is to provide a 22-38 L/hr. seal flush with filtered water, a rotameter, throttle valve, and solenoid operated isolation valve interlocked with an auxiliary contact of the motor starter.

.2 Alternative: Mechanical Seal system specifically designed to require no seal flush: The mechanical seal shall be located immediately behind the impeller hub to eliminate the stuffing box and maximize the flushing available from the impeller pumpout vanes. The seal shall be a cartridge-type mechanical seal with Viton O-rings and silicon carbide faces. This cartridge seal shall be a pre-assembled, and pre-tested so that no seal settings or adjustments are required from the installer. Any springs used to push the seal faces together must be shielded from the fluid to be pumped. The cartridge shall also include a 17-4PH, heat-treated seal sleeve and a CF8M stainless steal seal gland.

.11 Inlet Manifold:

.1 Shall be cast ductile iron assembly mounted horizontally with a 125 lb. inlet flange, ½"-NPT pressure tap, cleanout, drain connection and mounting feet.

.12 Shaft Coupling:

.1 Bearing housing and motor stool design is to provide accurate, self-aligning mounting for a C-flanged electric motor. Pump and motor coupling shall be T.B. Woods Sureflex elastomeric type.

.13 Optional Belt Drive:

.1 Adjustable brackets shall be used to support an over-head or side mounted motor. Sheaves and belts shall be properly sized for horsepower ratings, and all guards are to be supplied with the belt drive system.

.14 Stainless Steel Nameplates:

.1 Shall be attached to the pump and drive motor giving the manufacturer's model and serial number, rated capacity, head, speed and all pertinent data.

.15 Fits and Hardware:

.1 The volute/casing, suction cover, stuffing box cover, and frame shall be manufactured with concentric shoulder fits for accurate alignment. All machined bolts, nuts, and capscrews shall be of the hex-head type and will not require the use of any special tools.

.16 Paint:

.1 Prior to paint: blast and clean per SSPC-SP10.

.2 Primer: primer paint with one coat of ICI Devoe Bar-Rust 233H for a DFT or 4-6 mils.

.3 Top Coat: Apply top coat with ICI Devoe Bar-Rust 235 Epoxy for a DFT of 4 to 8 mils.

.4 Color Custom Grey. Total DFT of 8 to 16 mils.

.17 Vibration Limitations (Field):

.1 The limits of vibration as set forth in the standards of the Hydraulic Institute shall govern.

.18 Testing:

.1 A certified factory performance test shall be performed on each pumping unit in accordance with Hydraulic Institute Standards, latest edition. Tests shall be sufficient to determine the curves of head, input horsepower, and efficiency relative to capacity from shutoff to 150% of design flow. A minimum of six points, including shutoff, shall be taken for each test. At least one (1) point of the six (6) shall be taken as near as possible to each specified condition.

2.3 Motors

.1 Motor types, voltages, service conditions and power ratings are indicated in the detailed pump specification sheets.

.2 Motors shall comply with the provisions of Section 26 05 81.

2.4 Control Panel

.1 Control panels shall comply with the provisions of Section 40 10 01 - Enclosures, Section 40 30 11 - Miscellaneous Panel Device and Section 40 30 21 - Power Supplies.

.2 I/Os from control panels to be interfaced with Main Plant System via hardwired as shown on P&IDs. In addition to hardwired I/Os, provide Modbus TCP/IP link for additional monitoring status to Main Plant System. If this is not available, notify the Contract Administrator immediately and revise I/Os to hardwired interface to Main Plant System.

2.5 Balancing

.1 Dynamically balance the pumps.

2.6 Spare Parts

.1 Provide all spare parts, except lubricants, which would normally be required for one (1) year's operation.

.2 Provide a list of all spare parts which would be expected to be required under normal conditions, for a period of five (5) years. At the Contract Administrator's request, provide a price for these parts.

2.7 Acceptable Manufacturers

.1 Vaughan

.2 Mechanical Flushes Seal Systems and Pumps have to be supplied be the same manufacturer.

3. EXECUTION

3.1 Manufacturer's Representative

.1 Manufacturer's Representative shall be required to attend the site to train staff, and to witness installation and testing to ensure the equipment is installed and operated as intended.

.2 The minimum periods shall be as follows:

.1 Installation and testing: one (1) day.

.2 Staff Training: one (1) day.

3.2 Installation Training

.1 Instruct the installer in the methods and precautions to be followed in the installation of the pumps.

.2 The Manufacturer's Representative shall verify the installer's understanding by completing Form 101, included in Section 01 65 00.

3.3 Installation

.1 Verify satisfactory delivery of the equipment by completing Form 100.

.2 Ensure that each pump is installed and aligned in accordance with Section 43 20 10 as required to provide satisfactory service.

.3 Cooperate with the installer to fulfill the requirements for satisfactory installation as documented by Form 102, included in Section 01 65 00.

3.4 Testing

.1 Ensure that each pump, including all component parts, operates as intended.

.2 Cooperate with the installer to fulfill the requirements for satisfactory performance of the equipment as documented by Form 103, included in Section 01 65 00.

.1 The Manufacturer's Representative shall provide the services of factory trained instructors for the purpose of training the City's personnel in the proper operation and maintenance of the equipment as documented by Form T1 and T2.

3.5 Commissioning

.1 Attend during commissioning of the process system which includes the pump specified in this Section to ensure that each pump functions as intended in the process system.

END OF SECTION

EQUIPMENT DATA SHEET

Description:	Scum Recirculation Chopper Pumps 2
	P-P3221
Number:	1
Design Conditions:	
Liquid:	Scum
Liquid temperature:	5-25°C
Solids content:	1-10%
NPSH Available:	9 m
Minimum solids passing:	75 mm
Rating Point:	
Rated Flow:	60 L/s
Rated TDH:	6.9 m
Static Head	4.3 m
Construction:	
Suction Connection:	200 mm
Discharge Connection:	150 mm
Flange Rating:	Class 125
Casing Material:	Cast Iron
Driver:	
Drive Type:	VFD
Motor Type:	Electric motor
Phases/Voltage/Frequency:	3-phase/600 V/60 Hz
Max Motor Speed:	1750 rpm
Estimated Motor Size:	10 HP
Motor Enclosure	Totally enclosed fan cooled
Classification:	As per Section 26 05 00
Accessories:	
Pressure Gauge(s)	Pressure Gauge
Pressure Switch(es)	
Acceptable Manufacturers:	Vaughan
	Approved equal

EQUIPMENT DATA SHEET

Description:	Scum Transfer Chopper Pumps 3 & 4
	P-P3222 & P-P3222
Number:	2
Design Conditions:	
Liquid:	Scum
Liquid temperature:	5-25°C
Solids content:	1-10%
NPSH Available:	9 m
Minimum solids passing:	75 mm
Rating Point:	
Rated Flow:	12 L/s
Rated TDH:	20.9 m
Static Head	10.6 m
Construction:	
Suction Connection:	150 mm
Discharge Connection:	75 mm
Flange Rating:	Class 125
Casing Material:	Cast Iron
Driver:	
Drive Type:	VFD
Motor Type:	Electric motor
Phases/Voltage/Frequency:	3-phase/600 V/60 Hz
Max Motor Speed:	1750 rpm
Estimated Motor Size:	10 HP
Motor Enclosure	Totally enclosed fan cooled
Classification:	As per Section 26 05 00
Accessories:	
Pressure Gauge(s)	Pressure Gauge
Pressure Switch(es)	
Acceptable Manufacturers:	Vaughan
	Approved equal

END OF SECTION

PEDESTAL DRY PIT CHOPPER PUMP

1. GENERAL

1.1 Work Included

.1 Supply and supervision of the installation, testing, and commissioning of pedestal, single stage, end suction, centrifugal chopper pumps specifically for municipal applications.

.2 The Work will comprise of a centrifugal chopper pump application (Scum). It is the responsibility of the Construction Contractor to assess and evaluate information provided, including specifications, drawings, design rationale and process control description. The Construction Contractor shall provide appropriate justification (i.e. process calculation) for the selection and configuration.

.3 The pedestal chopper pumps shall be specifically designed to pump waste solids at heavy consistencies without plugging or dewatering of the solids. Materials shall be chopped/macerated and conditioned by the pump as an integral part of the pumping action. The pump must have demonstrated the ability to chop through and pump high concentrations of solids such as plastics, heavy rags, grease and hair balls, wood, paper products and stringy materials without plugging, both in tests and field applications.

1.2 Submittals

.1 Shop Drawings:

.1 Make, model, weight, power, and cross sectional details and colour brochures of each equipment assembly.

.2 Complete catalog information, descriptive literature, Specifications, and identification of materials of construction.

.3 Performance data curves showing head, capacity, horsepower demand, and pump efficiency over the entire operating range of the pump, from shutoff to maximum capacity. Indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the guarantee point.

.4 Detailed Drawings showing the equipment dimensions, size, and locations of connections and weights of associated equipment.

.5 Power and control wiring diagrams, including terminals and numbers.

.6 Complete motor nameplate data, as defined by NEMA, motor Manufacturer, and including any motor modifications.

.7 Factory finish system.

.8 Size, length and spacing of anchor bolts or attachment to the foundations or supports.

.9 External utility requirements air, water, power, etc. for each component.

.10 Control Panel external face layout and inter layout drawings and electrical wiring diagrams.

.2 Quality Control Submittals:

.1 Factory Functional and Performance Test Reports.

.2 Manufacturer's certification of compliance that the factory finish system is identical to the requirements specified herein.

.3 Special shipping, storage and protection, and handling instructions.

.4 Manufacturer's printed installation instructions.

.5 Suggested spare parts list to maintain the equipment in service for a period of five (5) years.

.6 Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.

.7 List special tools, materials, and supplies furnished with equipment for use prior to and during start-up and for future maintenance.

.8 O&M manual: Provide for incorporation in an Operation and Maintenance Manual. Include complete description of operation together with general arrangement and detailed drawings, wiring diagrams for power and control schematics, status information to the plant control system (PCS), parts catalogues with complete list of repair and replacement parts, with section drawings, illustrating the connections and identifying numbers.

1.3 Coordination

.1 Coordinate with other Divisions to ensure there are no conflicts in the work.

.2 Coordinate all process equipment power requirements and revisions to electrical distribution system. Electrical distribution system shall include, but not limited to, equipment dimensions, circuit breakers, cabling, working space, and clearance requirements at no additional cost to the project.

.3 Coordinate all process equipment control and monitoring requirements and revisions to Plant Control System. Plant Control System shall include, but not limited to, cabling, PLC cards and network switches at no additional cost to the project.

2. PRODUCTS

2.1 Detailed Pump Specification Sheets

.1 Specific pumps are listed in the detailed specification sheets.

2.2 Design

.1 Impeller:

.1 Shall be semi-open type with pump out vanes to reduce seal area pressure. Chopping/maceration of materials shall be accomplished by the action of the cupped and sharpened leading edges of the impeller blades moving across the cutter bar at the

intake openings, with a maximum set clearance between the impeller and cutter bar of 0.015-0.025” cold. Impeller shall be cast alloy steel heat treated to minimum Rockwell C 60 and dynamically balanced. The impeller shall be keyed to the shaft and shall have no axial adjustments and no set screws.

.2 Volute Casing and Back Pull-out Plate:

.1 The pump casing shall be of volute design, spiraling outward to the 125 lb. flanged centerline discharge. Back pull-out design shall incorporate jacking bolts for accurate adjustment of impeller-to-cutter bar clearance and shall allow removal of pump components without requiring disconnection of casing from inlet or discharge piping. Casing & backplate shall be ductile cast iron with all water passages to be smooth, and free of blowholes and imperfections for good flow characteristics. A pressure tap shall be included on or near the discharge flange. Backplate shall include a replaceable Rockwell C 60 steel cutter adjustable for 0.005-0.015" clearance to cut against the rotating impeller pumpout vanes for removing fiber and debris.

.3 Cutter Bar Plate:

.1 Shall be recessed into the pump bowl and shall contain at least 2 shear bars extending diametrically across the intake opening to within 0.010-0.020” of the rotating cutter nut tooth, for the purpose of preventing intake opening blockage and wrapping of debris at the shaft area. Chopper pumps utilizing individually mounted shear bars shall not be acceptable. Cutter bar shall be alloy steel heat-treated to minimum Rockwell C 60.

.4 Cutter Nut:

.1 The impeller shall be secured to the shaft using a cutter nut, designed to cut stringy materials and prevent binding using a raised, rotating cutter tooth. The cutter nut shall be cast steel heat treated to minimum Rockwell C 60.

.5 Upper Cutter:

.1 Shall be threaded into the back pull-out adapter plate behind the impeller, designed to cut against the pump-out vanes and the impeller hub, reducing and removing stringy materials from the mechanical seal area. Upper cutter shall be cast steel heat treated to minimum Rockwell C 60. The upper cutter teeth are positioned as closely as possible to the center of shaft rotation to minimize cutting torque and nuisance motor tripping. The ratio of upper cutter cutting diameter to shaft diameter in the upper cutter area of the pump shall be 3.0 or less.

.6 Pump Shafting:

.1 Shall be heat treated alloy steel.

.7 Bearings:

.1 Shall be oil-bath lubricated with ISO Gr. 100 turbine oil. Shaft thrust in both directions shall be taken up by two (2) back-to-back mounted single-row angular contact ball bearings. Two (2) adjacently mounted single-row radial bearings shall also be provided. B10 bearing life shall be minimum 100,000 hours.

.8 Bearing Housing:

.1 Shall be ductile cast iron and machined with piloted bearing fits for concentricity of all components. Bearing housing shall include a side-mounted site glass. Viton® double lip seals riding on stainless steel shaft sleeves are to provide sealing at each end of the bearing housing. Thrust bearings are mounted in an adjustable cartridge to allow external upper cutter adjustment.

.9 Stuffing Box:

.1 Mechanical seal with no seal water flush as described below does not require stuffing box.

.10 Seal:

.1 Mechanical Seal system specifically designed to require no seal flush: The mechanical seal shall be located immediately behind the impeller hub to eliminate the stuffing box and maximize the flushing available from the impeller pumpout vanes. The seal shall be a cartridge-type mechanical seal with Viton O-rings and silicon carbide faces. This cartridge seal shall be a pre-assembled, and pre-tested so that no seal settings or adjustments are required from the installer. Any springs used to push the seal faces together must be shielded from the fluid to be pumped. The cartridge shall also include a 17-4PH, heat-treated seal sleeve and a CF8M stainless steal seal gland.

.11 Inlet Manifold:

.1 The pump assembly shall be mounted vertically on a 90 degree carbon steel elbow with a Class 150 inlet flange, cleanout, 1/4" NPT suction pressure tap, drain connection and pedestal base.

.12 Shaft Coupling:

.1 Bearing housing and motor stool design is to provide accurate, self-aligning mounting for a C-flanged electric motor. Pump and motor coupling shall be T.B. Woods Sureflex elastomeric type.

.13 Stainless Steel Nameplates:

.1 Shall be attached to the pump and drive motor giving the manufacturer’s model and serial number, rated capacity, head, speed and all pertinent data.

.14 Fits and Hardware:

.1 The volute/casing, suction cover, stuffing box cover, and frame shall be manufactured with concentric shoulder fits for accurate alignment. All machined bolts, nuts, and capscrews shall be of the hex-head type and will not require the use of any special tools.

.15 Paint:

.1 Prior to paint: blast and clean per SSPC-SP10.

.2 Primer: primer paint with one coat of ICI Devoe Bar-Rust 233H for a DFT or 4-6 mils.

.3 Top Coat: Apply top coat with ICI Devoe Bar-Rust 235 Epoxy for a DFT of 4 to 8 mils.

.4 Color Custom Grey. Total DFT of 8 to 16 mils.

.16 Vibration Limitations (Field):

.1 The limits of vibration as set forth in the standards of the Hydraulic Institute shall govern.

.17 Testing:

.1 A certified factory performance test shall be performed on each pumping unit in accordance with Hydraulic Institute Standards, latest edition. Tests shall be sufficient to determine the curves of head, input horsepower, and efficiency relative to capacity from shutoff to 150% of design flow. A minimum of six points, including shutoff, shall be taken for each test. At least one (1) point of the six (6) shall be taken as near as possible to each specified condition.

2.3 Motors

.1 Motor types, voltages, service conditions and power ratings are indicated in the detailed pump specification sheets.

.2 Motors shall comply with the provisions of Section 26 05 81.

2.4 Control Panel

.1 Control panels shall comply with the provisions of Division 40.

.2 I/Os from control panels to be interfaced with Main Plant System via hardwired as shown on P&IDs. In addition to hardwired I/Os, provide Modbus TCP/IP link for additional monitoring status to Main Plant System. If this is not available, notify the Contract Administrator immediately and revise I/Os to hardwired interface to Main Plant System.

2.5 Balancing

.1 Dynamically balance the pumps.

2.6 Spare Parts

.1 Provide all spare parts, except lubricants, which would normally be required for one (1) year's operation.

.2 Provide a list of all spare parts which would be expected to be required under normal conditions, for a period of five (5) years. At the Contract Administrator's request, provide a price for these parts.

2.7 Acceptable Manufacturers

.1 Vaughan.

.2 Mechanical Flushless Seal Systems and Pumps have to be supplied by the same manufacturer.

3. EXECUTION

3.1 Manufacturer's Representative

.1 Manufacturer's Representative shall be required to attend the site to train staff, and to witness installation and testing to ensure the equipment is installed and operated as intended.

.2 The minimum periods shall be as follows:

.1 Installation and testing: one (1) day.

.2 Staff Training: one (1) day.

3.2 Installation Training

.1 Instruct the installer in the methods and precautions to be followed in the installation of the pumps.

.2 The Manufacturer's Representative shall verify the installer's understanding by completing Form 101, included in Section 01 65 00.

3.3 Installation

.1 Verify satisfactory delivery of the equipment by completing Form 100.

.2 Ensure that each pump is installed and aligned in accordance with Section 43 20 10 as required to provide satisfactory service.

.3 Cooperate with the installer to fulfill the requirements for satisfactory installation as documented by Form 102, included in Section 01 65 00.

3.4 Testing

.1 Ensure that each pump, including all component parts, operates as intended.

.2 Cooperate with the installer to fulfill the requirements for satisfactory performance of the equipment as documented by Form 103, included in Section 01 65 00.

.1 The Manufacturer's Representative shall provide the services of factory trained instructors for the purpose of training the City's personnel in the proper operation and maintenance of the equipment as documented by Form T1 and T2.

3.5 Commissioning

.1 Attend during commissioning of the process system which includes the pump specified in this Section to ensure that each pump functions as intended in the process system.

END OF SECTION

EQUIPMENT DATA SHEET

Description:	Scum Recirculation Chopper Pumps 1
	P-P3211
Number:	1
Design Conditions:	
Liquid:	Scum
Liquid temperature:	5-25°C
Solids content:	1-10%
NPSH Available:	9 m
Minimum solids passing:	75 mm
Rating Point:	
Rated Flow:	60 L/s
Rated TDH:	6.9 m
Static Head	4.3 m
Construction:	
Suction Connection:	200 mm
Discharge Connection:	150 mm
Flange Rating:	Class 125
Casing Material:	Cast Iron
Driver:	
Drive Type:	VFD
Motor Type:	Electric motor
Phases/Voltage/Frequency:	3-phase/600 V/60 Hz
Max Motor Speed:	1750 rpm
Estimated Motor Size:	10 HP
Motor Enclosure	Totally enclosed fan cooled
Classification:	As per Section 26 05 00
Accessories:	
Pressure Gauge(s)	Pressure Gauge
Pressure Switch(es)	
Acceptable Manufacturers:	Vaughan
	Approved equal

EQUIPMENT DATA SHEET

Description:	Scum Transfer Chopper Pumps 1, and 2
	P-P3212, P-P3213
Number:	2
Design Conditions:	
Liquid:	Scum
Liquid temperature:	5-25°C
Solids content:	1-10%
NPSH Available:	9 m
Minimum solids passing:	75 mm
Rating Point:	
Rated Flow:	12 L/s
Rated TDH:	20.9 m
Static Head	10.6 m
Construction:	
Suction Connection:	150 mm
Discharge Connection:	75 mm
Flange Rating:	Class 125
Casing Material:	Cast Iron
Driver:	
Drive Type:	VFD
Motor Type:	Electric motor
Phases/Voltage/Frequency:	3-phase/600 V/60 Hz
Max Motor Speed:	1750 rpm
Estimated Motor Size:	10 HP
Motor Enclosure	Totally enclosed fan cooled
Classification:	As per Section 26 05 00
Accessories:	
Pressure Gauge(s)	Pressure Gauge
Pressure Switch(es)	
Acceptable Manufacturers:	Vaughan
	Approved equal

END OF SECTION

1. GENERAL

1.1 Description

.1 Provide a skid mounted carbon adsorption odour control system as indicated, and in compliance with the Contract Documents.

.2 Scope includes:

.1 Furnish, install and test the skid mounted carbon adsorption odour control system with performance as specified herein. The odour control system shall include an epoxy-coated steel skid, two (2) insulated FRP carbon adsorption vessels with an integrated FRP exhaust stack, FRP odour control process fans, process fan VFD and control panel, motorized dampers, expansion joints, mist eliminators, dual carbon media bed, instrumentation, and all appurtenances to make the system operable, as indicated and as specified.

.2 The skid mounted carbon adsorption odour control system is to be the end product of a single system manufacturer.

.3 The location of the skid mounted carbon adsorption odour control system is as shown on the Contract Drawings on the exterior. Winterize the unit for ambient conditions in Winnipeg.

1.2 References

.1 ASTM International (ASTM):

.1 C582: Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment.

.2 D648: Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.

.3 D3982: Standard Specification for Contact Molded “Fiberglass” Ducts.

.4 D4385: Standard Practice for Classifying Visual Defects in Thermosetting Reinforced Plastic Protruded Products.

.5 D746: Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.

.6 D790: Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

.7 D1505: Standard Test Method for Density of Plastics by the Density-Gradient Technique.

.8 D1525: Determination of Vicat Softening Temperature of Plastics.

.9 D1693: Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.

.10 D1998: Standard Specification for Polyethylene Upright Storage Tanks.

.11 D2583: Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.

.12 D3299: Standard Specification for Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks.

.13 D4097: Standard Specification for Contact-Molded Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks.

.14 D4167: Standard Specification for Fiber-Reinforced Plastic Fans and Blowers.

.15 E84: Standard Test method for Surface Burning Characteristics of Building Materials.

.16 E679: Standard Practice for Determination of Odour and Taste Thresholds by a Forced-Choice Ascending Concentration Series Method of Limits.

.2 Fiberglass Reinforced Plastics Institute, Inc. (FRPI):

.1 Laminate Certification Manual.

.3 International Organization for Standardization (ISO):

.1 17855-1: Plastics – Polyethylene (PE) molding and extrusion materials.

.2 19069-1: Plastics – Polypropylene (PP) molding and extrusion materials.

.4 National Bureau of Standards (NBS):

.1 PS 15: Custom Contact Molded Reinforced Chemical Resistant Process Equipment.

.5 American Society for Testing and Materials (ASTM):

.1 ASTM D2854-09(2014), Standard Test Method for Apparent Density of Activated Carbon.

.2 ASTM D2867-09(2014), Standard Test Methods for Moisture in Activated Carbon.

.3 ASTM D3467-04(2014), Standard Test Method for Carbon Tetrachloride Activity of Activated Carbon.

.4 ASTM D3802-16, Standard Test Method for Ball-Pan Hardness of Activated Carbon.

.6 Air Movement and Control Association (AMCA):

.1 99-0401: Classifications for Spark Resistant Construction.

.2 204: Balance Quality and Vibration Levels for Fans.

.3 210: Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating.

.7 American National Standards Institute (ANSI):

.1 S2.19 G1.0: American National Standard Mechanical Vibration – Balance Quality Requirements of Rigid Rotors.

1.3 Submittals

.1 Submit the following Shop Drawings in accordance with Section 01 33 00.

.1 Certified shop and working drawings. Drawings for the skid mounted carbon adsorption system shall include a complete description of the laminate and material of construction as specified within this section and be accompanied by a detailed post-cure procedure that will be utilized.

.2 Drawings shall include plan views, sectional views, title block, and details of all related items. In cases where certain information is proprietary and is omitted, provided a statement indicating that the information is proprietary and is being omitted.

.3 Files shall include Tag Names, Parts List (identifying each component), Dimensions, and connection sizes.

.4 Files shall be drawn to scale.

.5 Drawings shall be in conformance with all other requirements as specified in this Specification.

.6 Drawings shall show access paths for maintenance activities and provide sufficient clearance for equipment removal.

.7 Drawings are to show the supplied odour treatment equipment within the odour treatment equipment area as shown on the Contract Drawings.

.8 Drawings are to coordinate with and show the locations of where the ductwork, piping, and other services connect to the odour treatment equipment as shown on the Contract Drawings.

.9 Drawings to include control panel elementary diagrams for pre-wired panels. Include, in the diagrams, control devices and auxiliary devices (e.g. relays, alarms, fuses, lights, fans, and heaters). The diagrams are to be fully comprehensive so that every circuit loop can be followed completely. Indicate the types of loads, switches, transducers and power supplies such as motors, relays, lights, indicators, mechanical float, isolators, signal selectors, dedicated 24 V DC power suppliers, etc. Number and identify each component circuit and terminal. Also show wiring terminals and devices which are external to the panel including items supplied by the Contractor. Identify all wires/cables, enclosures, terminals, and devices. Show tag numbers.

.10 Certified fan performance curves for the specified operating conditions.

.11 Fan sizing calculations stamped by a registered Professional Engineer licensed to practice in the Province of Manitoba.

.12 P&ID schematic and wiring schematic with interconnection diagram showing description of operations. List component identification of schematic diagrams as stated herein, along with component instruction manual references.

.13 Manufacturer's literature and specifications. Show catalog dates.

.14 Operating and maintenance instructions and parts list.

.15 In operating instructions incorporate a process functional description of the entire system including system schematics.

.16 In maintenance instructions, clearly define requirements for particular system components, and explain special calibration and test procedures.

.17 Provide troubleshooting and maintenance guides for all equipment.

.18 Provide a maintenance schedule for all components of the odour treatment system.

.19 Clearly mark all drawings and provide all technical data for the odour treatment equipment including, equipment schedule, bill of materials, rated capacities, material of construction, layouts and construction details of all components. Show dimensions, mounting and external connection details, and supports on all drawings.

.20 Number and identify all equipment to correspond with terminology on drawings. Also use these numbers on all submittal sheets and Shop Drawings.

.21 List of five (5) operating reference installations in which the manufacturer has supplied the same medias which will be used for the application specified herein.

.22 Provide performance data for each reference installation.

.23 Provide current (verified) contact information for each reference installation.

.24 Submit details of:

.1 Vessel construction material.

.2 Resin Type.

.3 Types and amounts of filler.

.4 Corrosion liner description.

.5 Reinforcement types for hand lay-up or chopped laminates.

.6 Gel coat and UV inhibitor.

.7 Material final color.

.8 Shop test results.

.9 Qualifications of field service technician.

.10 Schematic control and power wiring diagrams.

.11 Shop and Field inspections reports.

.12 List of recommended spare parts other than those specified.

.13 Recommendations for short- and long-term storage of shipped and spare parts.

.14 Special tools.

.15 Shop and field-testing procedures and equipment to be used.

.16 Manufacturer's product data, specifications, and color charts for shop painting.

.17 Provide documentation showing material compatibility and corrosion resistance with process air and fluids as specified.

.18 The most recent ISO 9000 series certification.

.19 A copy of the contract mechanical process, electrical and instrumentation drawings, with addenda that are applicable to the equipment specified in this section, marked to show all changes necessary for the equipment proposed for this specification section. If no changes are required, mark all drawings with "No changes required".

.20 Failure to include all drawings applicable to the equipment specified in this Section will result in rejection of the entire submittal with no further review.

.21 A copy of this Specification Section with addenda and all referenced Specification Sections with addenda, with each paragraph check-marked to indicate Specification compliance or marked to indicate requested deviations and clarifications from the specified requirements.

.22 If deviations and clarifications from the Specifications are indicated, therefore requested by the Contractor, provide a detailed written justification for each deviation and clarification.

.23 Failure to include a copy of the marked-up Specification Sections and or the detailed justifications for any requested deviation or clarification will result in rejection of the entire submittal with no further review and consideration.

1.4 Spare Parts

.1 Furnish and deliver to the City at the Site of Work the following spare parts, all identical and interchangeable with similar parts installed in the Work:

.1 Two (2) differential pressure gauges, sized as necessary for the odour control system.

.2 Two (2) spare gaskets of all types, materials and sizes for the odour control system.

.3 Two (2) spare mist eliminator pads for the odour control system.

.4 Fan spare parts:

.1 Two (2) complete sets of fan inboard and outboard bearings.

.2 Two (2) complete sets of motor bearings.

.3 Two (2) sets of seals, packing, and gaskets required for fan impeller/shaft assembly replacement.

.4 Two (2) fan impellers and shaft assemblies.

.5 Two (2) sets of V-belts.

.6 Two (2) additional flexible connections.

1.5 Quality Assurance

.1 The system shall be the product of one (1) manufacturer, who shall be responsible for the design coordination and proper operation of this equipment. The manufacturer shall ensure the satisfactory installation of the equipment, and the satisfactory performance that meets the performance requirements as specified herein. Any modifications or revisions required to meet the satisfactory installation and performance of the odour treatment equipment will be at no additional cost to the City.

.2 Systems shall be a manufacturer’s standard cataloged product and modified to provide compliance with the drawings, specifications, and the service conditions specified herein.

.3 Do work required by and in accordance with applicable provincial and federal legislation and codes; arrange for inspections and tests required by these codes; and provide complete systems ready for use. Provide vessels and accessories that conform to applicable safety standards, including those for safety of personnel.

.4 Provide components to manufacturer's standard for service specified and indicated unless otherwise required.

.5 Provide components and accessories of manufacturers' latest and proven design.

.6 Services of Manufacturer's Representative as specified herein.

.7 FRP Fabricator: demonstrate, through past records, their capability in successful manufacturing of filament-wound fiberglass.

.8 FRP vessel fabricator's quality assurance supervisor: minimum ten (10) years' experience in the fabrication of fiberglass structures.

.9 If equipment proposed is heavier, larger, different rotation, or discharge arrangement than specified and indicated; provide all structural, architectural, mechanical, electrical and plumbing revisions at no additional cost to the City. Odour treatment equipment and accessories to fit within the odour treatment areas as shown in the Contract Drawings.

.10 If equipment is heavier than specified, the Contractor shall provide all hoisting equipment sized to maintain the minimum safety factor between the specified maximum equipment weight and the lifting capacity of the hoisting equipment indicated and specified.

1.6 Warranty

.1 Comply with the requirements specified in Section 01 78 00.

2. PRODUCTS

2.1 Manufacturers and Products

.1 Acceptable Manufacturers:

.1 ECS Environmental Solutions.

.2 Continental Carbon Group.

.3 Unisorb Canada.

.2 Supply products from a single manufacturer responsible for the complete skid mounted carbon adsorption odour control system, complete with all features and accessories in this specification.

.3 The manufacturer is to have a minimum of ten (10) years of experience in the design and supply of odour control treatment equipment and carbon adsorption media.

.4 The skid mounted carbon adsorption odour control system is to be supplied in the location shown on the Contract Drawings and specified herein.

.5 The Contractor is to install the manufacturer supplied equipment in accordance with the manufacturer's detailed instructions.

.6 The Contractor is to supply and install all wiring and power cables.

.7 Equipment drain connections, sample ports with ball valves, and fittings are to be supplied and installed by the manufacturer. Insulated and heat traced drain piping external to the skid mounted carbon adsorption odour control system is to be supplied and installed by the Contractor in accordance with the manufacturer's detailed instructions. All drain piping that is above grade, and to a depth of 2.7 m below grade, is to be heat traced and insulated.

.8 Supply products modified as necessary by the manufacturer to provide the specified features and to meet the specified operating conditions.

.9 All electrical equipment, instrumentation, and panels installed within 1 m of the odour control ductwork, dampers, expansion joints, odour control fans, and the carbon adsorption vessels are to be supplied explosion proof for a Class 1 Division 2 rated environment.

2.2 Performance Requirements

.1 Process parameters:

	Approximate NEWPCC Design Parameters
Tag(s)	
Design Airflow Rate, L/s	193
Normal Airflow Rate, L/s	129
Avg. Inlet RH, %	>90
Air Inlet Temperature, °C	-40 to 40
Outdoor Air Temperature, °C	-40 to 40

	Approximate NEWPCC Design Parameters
Carbon Unit Quantity, ea	2
Average Loadings	
Avg. H2S, ppm	5
Avg. TRS, ppm	0.5
Avg. NH3	1
Avg. Odor, ou	3,200
Maximum Loadings	
Max. H2S, ppm	10
Max. TRS, ppm	2
Max. NH3, ppm	2
Max. Odor, ou	8,100
Removal Performance	
H2S Removal, %	99
TRS Removal, %	>90
NH3 Removal. %	>90
Total Odor Removal, %	>90

.2 The odour control system is to be designed for continuous twenty-four (24) hour, seven (7) days per week, operation.

.3 If one carbon unit is in need of repair the system shall operate using a single carbon unit at 75% of capacity.

2.3 Carbon Adsorption System Components

.1 Skid Mounted Carbon Adsorption Odour Control System:

.1 The odour control system shall include an epoxy-coated steel skid, two (2) insulated FRP carbon adsorption vessels with an integrated FRP exhaust stack, two (2) FRP odour control process fans, process fan VFDs and control panel, four (4) motorized dampers, four (4) expansion joints, two (2) mist eliminators, dual carbon media beds, instrumentation, and all appurtenances to make the system operable, as indicated and as specified.

.2 All equipment supplied is to be suitable for continuous operation in a corrosive foul air stream generated from the treatment of wastewater from a municipal wastewater treatment facility.

.3 The equipment is to be the manufacturer’s standard design modified to suit the requirements of the specifications. The design is to have been proven effective and reliable under similar operating conditions.

.4 The carbon adsorption odour control system equipment is to be able to withstand an internal operating pressure between -4.5 kPa to 4.5 kPa.

.5 The odour control system is to be designed to operate twenty-four (24) hours per day, seven (7) days per week.

.6 The carbon adsorber vessels shall be cylindrical and designed for single media bed configuration with airtight access hatches and ports for media installation, sampling, and removal.

.7 Carbon adsorption vessels are to be equipped with an exhaust stack discharging at a minimum of 3 m above the grade elevation.

.8 An FRP motorized dampers are to be provided on the inlet and outlet side of the odour control fans as shown on the Contract Drawings. The dampers are to be flange connected with the FRP ductwork.

.2 Carbon Adsorption Media:

.1 The carbon adsorption units shall be provided with a minimum of two (2) types of media to remove the odour contaminant concentrations described herein.

.2 One (1) media type shall be an activated carbon with a minimum H_2S breakthrough capacity of 0.20 g H_2S/cc, designed for removal of H_2S and contaminants found within humid gas stream from a wastewater facility process as specified above in Section 2.2.1.

.3 One (1) media type shall be a minimum 8% potassium permanganate impregnated dry media designed for removal of reduced sulfur compounds found within a humid gas stream from a wastewater facility process as specified above in Section 2.2.1.

.4 The medias are to last a minimum of one (1) year before requiring replacement.

.5 Carbon media arrangement and vessel to be designed so the airflow velocity through the carbon media is within 0.2 m/s to 0.3 m/s.

2.4 Configuration, Components, Features

.1 General:

.1 Auxiliary equipment as indicated in the Contract Drawings.

2.5 Carbon Absorption Vessels

.1 All materials and components used in the manufacture of this equipment shall be new and unused and free of defects and imperfections. The carbon adsorption vessels will be designed in accordance with the following requirements:

.1 The vessels are to be designed to handle air with the characteristics specified herein.

.2 The vessels are to be manufactured so that all parts are proportioned to have liberal strength and stiffness and to be especially adapted for the intended working conditions.

.3 Material of construction of the carbon adsorption vessels is to be FRP.

.4 For FRP construction, construct the vessels as follows:

.1 The inner shell is to be approximately 25% glass and 75% resin. Provide an internal C-glass surface veil liner for corrosion resistance.

.2 Resin (flame retardant versions only):

.1 Acceptable Products:

.1 Hetron FR922 by Ashland Chemical Co.

.2 Derakane 510C-350.

.3 Dion ver9300FR.

.4 Vipel K022-AC Series.

.3 Reinforcing material is to be commercial grade glass fiber containing a coupling agent to produce a suitable bond with the resin used.

.4 All materials are to be suitable for exposure to hydrogen sulfide fumes at a concentration of up to 300 ppm and sulfuric acid at a pH of 1.0.

.5 Ultraviolet absorbers are to be added to the exterior surface for improved weather resistance. Color samples are to be provided to the Contract Administrator for selection by the City.

.6 All surfaces are to be finished so as to obtain complete cure of the resin without air inhibition. The finished laminate is to be as free as commercially practicable from visual defects such as foreign inclusions, dry spots, air bubbles, pinholes and pimples. The vessels are to conform to the manufacturer's minimum standard for Barcol hardness.

.7 Vessel rigidity to be designed to prevent collapse, implosion or any other damage to the unit from operation of the suction fan at any point along its performance curve.

.5 The vessel is to be equipped with the accessories as listed below:

.1 Provide 316 stainless steel lifting lugs (minimum of 4) for use in transporting and placing the vessel.

.2 Provide hold downs (minimum of 4) each consisting of 316 stainless steel anchor bolts.

.3 Vessel connection flanges are to be compatible with connecting piping and ductwork.

.4 The vessels are to include the following:

.1 Flanged air-tight access hatch for inspecting and replacing media.

.2 A 200 mm flanged inlet air ductwork connection.

.3 200 mm no-loss exhaust stack.

.4 Magnehelic differential pressure gauge to measure pressure across the media bed including a condensate drain.

.5 50 mm Sch. 80 PVC vessel drain.

.6 Two (2) 50 mm air sampling ports with one located above the media bed and one below. Both air sampling ports are to be provided with a Sch. 80 PVC ball valve for isolation.

.7 Three (3) 50 mm media sampling ports located across the depth of the media bed to sample both installed media types. Media sampling ports are to be provided with a Sch. 80 PVC ball valve for isolation.

.8 316 stainless steel grounding rod.

.9 316 stainless steel nameplate.

.5 All bolts and fasteners are to be of 316 stainless steel material.

.6 All gaskets are to be EPDM.

.7 The carbon media bed shall be grounded with a 316 stainless steel rod to prevent static electricity from accumulating. The rod will be supplied by the manufacturer, for connection to grounding system by the Contractor.

.8 The vessel shall have an internal slope bottom constructed of FRP. Provide a minimum 1% slope on the floor of the vessel towards the drain to allow for condensation drainage.

.9 Vessel top and sidewall surfaces shall have a factory applied insulation barrier with outer composite skin to prevent condensation inside the unit. Condensation system shall be a minimum of 75 mm thick and have a 7 mm thick FRP filament wound outer skin. Outer skin shall have a lapped expansion joint to prevent cracking. Minimum R value of the insulation system shall be 25.

.10 The vessels are to be supplied with a no-loss vertical stack extending from the center of the top of the vessel.

.11 The media support is to be vinyl ester FRP grid type. Packing support plates and mid-span supports are to be suitable to support the weight of the packing and entrained recirculation solution.

.12 Media support:

.1 FRP grating supported by FRP I-beams are to be installed to support the weight of the medias.

.2 Openings in FRP grating shall be large enough to let inlet air to pass freely but not allow passage of media particles.

.3 A 25 mm mesh polypropylene screen shall be placed on the FRP grating to prevent media from falling through.

.4 The media support materials shall be corrosion resistant and selected for low pH resistance as appropriate for the process.

.5 The media support is to be capable of supporting the weight of the load of media required for the performance parameters listed in part 2.02 A., plus an additional 45 kg.

.6 The media support system is to be design such that it can be removed through the vessel hatches if needed.

2.6 Odour Control Process Fans

.1 The fans shall be a centrifugal industrial FRP fan that meets AMCA requirements. All parts of the fan that are exposed to the airstream shall be encapsulated in FRP with graphite impregnation to insure corrosion resistance and spark proof operation.

.2 The manufacturer is to provide all appurtenances, fittings, and accessories necessary for the proper functioning of the odour control centrifugal fans as specified herein. The odour control fans are to be provided loose for installation indoors.

.3 Fans and associated devices and equipment are to be suitable for conditions with an ambient temperature range between -40°C and 40°C.

.4 The odour control fans and equipment design provided by the manufacturer is to be appropriate for heavy-duty industry applications. The design and construction will be explosion proof suitable for a Class 1, Division 2, Group D hazardous classification area. Adequate protection of bearings, etc. shall be provided.

.5 The fans will be operated twenty-four (24) hours a day, seven (7) days a week.

.6 The fan wheels shall be of spark resistant construction in accordance with AMCA 99-0401 Type B standards.

.7 The fan shafts shall be constructed of 316 stainless steel material.

.8 The complete fan wheel and shaft assembly shall be statically and dynamically balanced in accordance with ANSI S2.19 G1.0 standards. The reports for the balancing shall be retained and included in the manufacturer's operating and maintenance manuals.

.9 All fans shall be equipped with the following features and accessories:

.1 Flanged inlet/outlet.

.2 200 mm fan inlet and outlet expansion joints. Expansion joints shall be secured to the fan inlet, outlet, and odour control ductwork by flange connections.

.3 50 mm Sch. 80 PVC coupling drain.

.4 Teflon Shaft Seal.

.5 Safety Shaft and Belt Guards.

.6 Constant-speed V-belt drive.

.7 A unified base with a minimum of four (4) neoprene vibration isolators. Vibrations shall be within the limits as described in ANSI/AMCA 204-96.

.8 316 stainless steel nameplate with fan model number, serial number, design flowrate, design pressure, maximum rpm, maximum hp, design gas pressure and temperature.

.10 Manufacturers:

.1 Universal Fan and Blower Ltd.

.2 The New York Blower Company.

.3 Verantis Environmental Solutions Group.

.11 The odour control fans shall meet the operating conditions specified in the table below, within an airflow with the parameters listed in Section 2.2.1. above;

	Drain Lift Station
Design Airflow Rate, L/s	193
Normal Airflow Rate, L/s	129
Inlet Static Pressure, kPa	-1.5
Outlet Static Pressure, kPa	1.5
Air Inlet Temperature, ^{o}C	-40 to 40
Ambient Air Temperature, ^{o}C	-40 to 40
Relative Humidity. %	>90

.12 The motor shall be TEFC heavy duty, and suitable for operation in a Class 1 Division 2 classified environment.

2.7 Odour Control Fan Control Panel

.1 The manufacturer shall provide a NEMA 4X fan local control panel as shown on the Contract Drawings. The fan local control panel is to be greater than 0.9 m away from the odour control ductwork and odour treatment equipment.

.2 The fan control panel will be shipped with the skid mounted carbon adsorption odour control system equipment, but will not be mounted to the skid. The Contractor is to install the fan control panel as shown on the Contract Drawings.

.3 The Contractor is to supply and install all field interconnection wiring and loss shipped instrument.

.4 The manufacturer shall provide the following transmitting instrumentation:

.1 Four (4) PITs (Pressure Indicating Transmitters).

.2 Two (2) TITs (Temperature Indicating Transmitters).

.3 Four (4) PDITs (Pressure Differential Indicating Transmitters).

.4 The Control Panel shall be capable of displaying the readings.

.5 Control panel shall include the following:

.1 575 V main circuit breaker.

.2 Control transformer – 120 V.

.3 REMOTE/OFF/LOCAL switch.

.4 Fan start/stop push buttons.

.5 Motorized damper position indication.

.6 E-stop.

.7 HMI Screen.

.8 Modbus communication to Plant PCS.

.9 Green “On” pilot light.

.10 Red Fault pilot light.

.11 Schneider Altivar 600/900 series VFD’s for the odour control fans.

.12 Dry interface contacts with minimum switching current 2 mA for:

.1 Odour control fan run.

.2 Odour control fan fail.

2.8 Mist Eliminator

.1 An inlet mist eliminator for grease and water droplet capture is to be provided for each carbon adsorption vessel. The mist eliminators are to be contained within an FRP housing that is to be flanged connected to the inlet and outlet ductwork. The mist eliminator is to be located as shown in the Contract Drawings.

.2 The mist eliminator pad is to be of stainless steel construction and capable of capturing droplets up to 2 µm in diameter.

.3 This mist eliminator pad is to be removable for maintenance through an access hatch on the side of the mist eliminator housing. The hatch is to be flanged and must be airtight for the air pressures indicated in this Section.

.4 A magnehelic differential pressure gauge is to be provided by the manufacture to indicate the pressure loss across the mist eliminator pad.

.5 The mist eliminator is to be provided by the manufacturer loose for installation as per the Contract Drawings.

2.9 Instrumentation

.1 The manufacturer is to provide Magnehelic style differential pressure gauges allowing determination of the pressure loss in inches of water column across the carbon media bed and mist eliminator pad. The range shall be 0 kPa - 3 kPa. Tubing shall be bonded to a solid acrylic plastic block that contains safety traps. Magnehelic shall be Dwyer or equal.

.2 Tubing is to be insulated by the Contractor.

2.10 Skid

.1 Epoxy-Coated steel skid:

.1 Sized to hold the odour control vessels as shown on the Contract Drawings.

.2 Lifting points for forklift shall be provided.

.3 Groundling lug shall be provided.

.4 Manufacturer to provide odour control equipment installed upon the skid when delivered to Site. Fan odour control panel, fans, motorized dampers, and mist eliminators are to be provided loose.

2.11 Acoustical Enclosure

.1 An acoustical fan enclosure shall be provided by the manufacturer if needed to reduce fan noise to 85 dBA at a distance of 1.5 m.

2.12 Auxiliary Equipment

.1 The Contractor is to provide all anchor bolts required for the complete installation of the equipment. All anchor bolts shall be 316 stainless steel unless otherwise specified in the Contract Documents.

.2 Flanges:

.1 For equipment, valves, and devices with integrally cast flanges, provide flanges in accordance with the dimensions and drilling of ANSI B16.1or ANSI B16.5 with bolt-holes straddling the vertical centerline.

.2 For equipment, valves, and devices with PVC flanges provide flanges in accordance with the dimensions and drilling of ASTM D2466-06, or ASTM D2467-06 with bolt-hole straddling the vertical centerline.

.3 For fabricated equipment and vessels, provide flanges of the same material as the equipment or vessel. Provide FRP equipment and vessels with FRP flanges. Provide flanges to the dimensions and drilling of ANSI B16.5.

3. EXECUTION

3.1 Installation

.1 General:

.1 Install equipment and appurtenances in accordance with the manufacturer's recommendations.

.2 Provide all materials and equipment required.

3.2 Skid Mounted Carbon Adsorption Odour Control System

.1 Manufacturer to provide all carbon adsorption odour control system equipment specified herein skid mounted unless noted otherwise.

.2 The Contractor is to install the skid mounted carbon adsorption odour control system along with all loose components in accordance with the manufacturer's recommendations.

.3 Install skid mounted carbon adsorption odour control system on a concrete pad as indicated on the Contract Drawings.

3.3 Field And Functional Testing

.1 After installation, perform all of the following full operational tests in presence of the City. Furnish all labor, materials and equipment required for such tests.

.1 Carbon Adsorption System:

.1 Factory test with water to the height of the overflow or the straight side height of the vessel, greater amount. Submit test data.

.2 The water level must be unchanged after twenty-four (24) hours with no visible signs of leakage or wall deflection exceeding 1/4 percent of span.

.3 Hydrostatic test may be witnessed by the Contract Administrator.

.2 Start-up:

.1 Provide the services of a factory-trained service technician, certified by the manufacturer to service the type of equipment herein specified, to assist in start-up operation.

.2 Tests to be performed consist of start-up and operation of entire system at design capacity, and verification of operation of drives and other components, without, overheating, leakage, cracking of parts, structural damage, jamming, binding, or other defects.

3.4 Start-up and Testing

.1 Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

.1 Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

.2 Comply with requirements for checkout, start-up, and testing in Section 01 91 31 - Commissioning Plan.

.3 Physical Checkout and Field Testing (Functional Completion Testing): Inspect grouting, location of anchor bolts; setting, leveling, alignment, field erection; coordination of piping, electrical and miscellaneous utility connections; certify proper installation:

.1 2 person-days

.4 Start-up: Calibrate, check alignment and perform a functional test with water or process fluid. Tests to include all items specified.

.1 1 person-day.

.5 Commissioning: Field performance test equipment specified.

.1 2 person-days.

.2 System Performance Testing:

.1 Performance Testing shall be completed in accordance with the requirements of Section 01 91 31 - Commissioning Plan, after the system start-up has been completed.

.2 Testing Requirements:

.1 Following the City approval of start-up results, provide services of an independent State qualified air testing laboratory to measure and report on efficiency and performance of the odour control system. Submit testing procedures of testing laboratory to the City at least fifteen (15) days prior to tests. Have manufacturer’s service technician present during system testing.

.2 Testing shall include certification that the units have been tested and rated in accordance with the applicable AMCA Standard Test Code and Certified Ratings Program and that they bear the AMCA seal. Odour performance testing shall follow ASTM/ANSI E679-19 "Standard Practice for Determination of Odour and Taste Threshold by a Forced-Choice Ascending Concentration Series Method of Limits"; and all testing shall be coordinated with the Contract Administrator.

.3 The Contractor is to set-up access platforms or scaffolding to for the performance testing to be completed.

.3 The manufacturer shall be aware that the Contractor is responsible for odour performance field testing; however, the manufacturer is responsible for the odour treatment equipment’s performance.

.4 If a test fails it must be redone at the expense of the manufacturer.

3.5 Training

.1 Training: Provide classroom and field operation and maintenance in accordance with Section 01 79 00 - Demonstration and Training.

.1 1 person-day.

.2 Coordinate training time with the Contract Administrator and City.

3.6 Field Touch-Up Painting

.1 After installation and approved testing by the Contract Administrator, Contractor shall apply touch-up paint to all scratched, abraded and damaged shop painted surfaces. Coating type and color shall match shop painting.

3.7 System Balancing

.1 Adjust manual and automatic control devices to balance airflows so they perform as indicated and specified.

.2 Balance air systems so each system is within 5% of the airflow values indicated on the Contract Documents.

.3 Submit report to the City outlining balancing procedures used; report to include:

.1 Type of measuring devices used.

.2 Air quantities at each outlet, damper and fan.

.3 Fan speeds.

.4 Fan suction and discharge pressures.

3.8 Contract Closeout

.1 Provide in accordance with Section 01 78 00.

END OF SECTION

ODOUR CONTROL DUCTWORK AND ACCESSORIES

1. GENERAL

1.1 Description

.1 Provide odour control ductwork for collection of foul odour air from locations as shown in the Contract Documents. Ductwork material includes HDPE and fiberglass reinforced plastic (FRP). Ductwork and accessories to be provided and installed as indicated and in compliance with Contract Documents.

1.2 References

.1 National Fire Protection Association (NFPA):

.1 255: Standard Method of Test of Surface Burning Characteristics of Building Materials, 2006 Edition.

.2 259: Standard Test Method for Potential Heat of Building Materials, 2013 Edition.

.2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):

.1 Thermoset FRP Duct Construction Manual, 2nd Edition.

.2 Accepted Industry Practice for Industrial Duct Construction.

.3 Seismic Restraint Manual: Guidelines for Mechanical Systems, 3rd Edition, 1981-2008.

.3 Underwriters Laboratories Inc. (UL):

.1 181: Standard for Factory-Made Air Ducts and Air Connectors (2013-07-25 edition).

.4 Local and National Building Codes.

1.3 Submittals

.1 Submit the following Shop Drawings in accordance with Section 01 33 00.

.2 Duct Fabrication Drawings:

.1 Manufacturer's Product data including details of materials, construction, dimensions of all components, layout, installation details, and finishes for the following items:

.1 HDPE and FRP ductwork.

.2 Ductwork insulation and jacketing.

.3 Duct-mounted sampling ports.

.4 Ductwork flanges.

.5 Sealants and gaskets.

.6 Butterfly dampers.

.7 Flexible connections.

.2 Structural engineering design calculations are to be stamped by a registered Professional Engineer licensed to practice in the Province of Manitoba.

.3 Drawn after actual site measurements are obtained.

.4 Drawn to a scale not smaller than 1:50, on drawing sheets of the same size as the Contract Drawings, detailing:

.1 Fabrication, assembly, and installation details including plans, elevations, sections, details of components, and attachments to other Work. Other Work includes facility process equipment such as screw presses, storage bins, and tanks.

.2 Duct layout, indicating pressure classifications, and sizes in plan view.

.3 Duct material and thickness.

.4 Reinforcing details and spacing.

.5 Seam and joint construction details.

.6 Spatial coordination with other systems installed in same space with duct systems.

.3 Informational Submittals in accordance with Section 01 33 00.

.1 Product Data:

.1 Submit Product data sheets for the equipment as specified herein. Product data sheets are defined as catalogue sheets, brochures, literature, technical data, performance charts, diagrams, specifications, instruction books, lubrications charts, maintenance instructions/schedule, spare parts lists and similar data used to illustrate quality, characteristics, capacity, maintenance, replacement parts, and performance of the supplied manufactured Products.

.2 Record Drawings:

.1 At Contract closeout, the Contractor shall submit record drawings of installed ductwork, accessories, and joints, in accordance with Section 01 78 00.

1.4 Quality Assurance

.1 Industry Standards:

.1 Unless otherwise indicated or specified in the Contract Documents, FRP ductwork shall be constructed and installed in accordance with the SMACNA duct construction standard relevant to ductwork system being provided. These standards are referenced in this Section as the SMACNA Manual, unless otherwise indicated in the Contract Documents.

.2 Comply with the ASHRAE Fundamentals Handbook recommendations, except as otherwise indicated in the Contract Documents.

.2 Manufacturers: Firms regularly engaged in manufacture of ductwork products of the types, materials, and sizes required, whose products have been satisfactorily used in similar service for a minimum of five (5) years.

.3 Ensure that the suppliers of duct and fitting components provide, on request, the following information:

.1 Laboratory performance data for duct, including leakage rate, bursting strength, collapse strength, seam strength, and pressure loss.

.2 Laboratory performance data for fittings, including zero length dynamic losses.

.4 Changes or alterations to layout or configuration of duct system shall be:

.1 Specifically approved in writing.

.2 Proposed layout shall provide original design results, without increasing system total pressure.

1.5 Delivery Storage and Handling

.1 The equipment and appurtenances shall be delivered to the site in a condition satisfactory to the Contract Administrator and any omissions, discrepancies or damage evident on delivery shall be addressed to the Contract Administrator’s satisfaction.

.2 The equipment shall be of sufficient strength and rigidity for normal handling during loading, transport, unloading, installation, and assembly. Supports and reinforcements shall be used to maintain the equipment integrity as required.

.3 Do not ship ducting by nesting small diameter components inside larger components.

.4 Protect shop-fabricated and factory-purchased ductwork, accessories, and purchased Products from damage during shipping, storage, and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.

.5 Protect flanged sections by bolting wooden blinds 2 inches greater than outside diameter of flange.

.6 For non-flanged components, use either rigid plugs inside ends to prevent deflection or protect with wooden boxes.

.7 Crate materials, wherever practical, prior to shipment.

.8 Firmly fasten and pad components shipped to prevent shifting or flexing of components after assembly.

.9 Lifting lugs shall be shop installed as required to permit safe handling during shipping and erection with conventional hooks or slings.

.10 The Contractor shall obtain the manufacturer's written instructions for precautions to be observed in connection with storing the equipment. A copy of all instructions shall be provided to the Contract Administrator.

.11 Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclose with waterproof wrapping.

.12 Protect ductwork from dirt, water, and debris. During storage on the Site, keep ends of ductwork covered to prevent foreign objects and water from entering ductwork.

2. PRODUCTS

2.1 General

.1 All materials and components used in the manufacture of this equipment shall be new and unused, and free of all defects and imperfections.

.2 All equipment supplied shall be suitable for continuous operation in a corrosive gas stream generated by the treatment of odours produced from municipal wastewater treatment systems.

.3 The Contractor shall install the odour control ductwork and accessories with strict adherence to the manufacturer's written instructions.

.4 Material and equipment to conform to the latest edition of all applicable standards, which are in force at the time of tendering, including those listed in Section 1.2. In the case of conflict between the requirements of these specifications and any standards, the more stringent requirement of the two applies.

2.2 Process Design Parameters

.1 Process design parameters and service conditions for the odour control ductwork and accessories are described as follows:

Process Parameters	
Hydrogen Sulphide, average ppm	5
Hydrogen Sulphide, peak ppm	10
Average Inlet RH, percent	>90
Maximum Working Pressure, kPa.	-4.5
Process Air Temperature, °C	-40 to 40
Outdoor Temperature, °C	-40 to 40

.2 All ductwork shall be air and watertight up to the pressures indicated in Section 2.2.1.

2.3 High-Density Polyethylene (HDPE) Ductwork

.1 The Contractor shall ensure that the manufacturer will fabricate, and supply, HDPE ductwork and accessories as shown on the Contract Drawings.

.2 All ductwork shall be air and watertight up to the design pressures indicated in Section 2.2.1.

.3 HDPE ductwork is to be suitable for underground service as shown on the Contract Drawings.

.4 Duct lengths, fittings, and flanged connections to be joined by thermal butt-fusion and shall be of the same type and compound of high-density polyethylene supplied by the same raw material supplier.

.5 Duct Design:

.1 The duct shall be made from high-density polyethylene resin compounds which meet the standards defined in ASTM D3350.

.2 The high-density polyethylene resin shall conform to Type PE 3408.

.3 Duct shall be capable of withstanding H-20 traffic loads.

.4 Duct shall have a maximum allowable hoop stress of 800 psi at 23°C.

.5 Duct shall have a standard dimension ratio of 17 in accordance with the requirements of ASTM F714.

.6 Hardware such as bolting, washers, and nuts shall be of 316 stainless steel material.

.6 Fittings:

.1 150 mm inch and smaller: Molded fittings, butt fusion jointed, conforming to ASTM D3261.

.2 200 mm inch and larger: Same as pipe, butt fusion jointed, conforming to ASTM D3350.

.3 All fittings shall have the same pressure rating and standard dimensions ratio as the HDPE duct.

.4 Drains shall be supplied as indicated on the Contract Drawings and be subject to the same pressure and corrosion design constraints as the ductwork.

.7 Flanges:

.1 HDPE duct shall be flanged connected to FRP duct by the use of an HDPE flange adapter as shown on the Contract Drawings.

.2 Flanges shall meet or exceed the requirements of ANSI B16.5, and ANSI B16.47 150lb flanges, and shall be suitable for the specified conditions within Section 2.2.1.

.3 The Contractor is to ensure suitable flange-to-flange mating for HDPE to FRP duct.

.4 Pressure performance of the backing ring shall equal the standard dimension ratio of the duct with a safety factor of 2.

.5 Stub ends shall have the same pressure rating and standard dimension ratio as the duct.

2.4 FRP Ductwork

.1 Ductwork shall be constructed in accordance with the SMACNA Manual.

.2 All ductwork shall be air and watertight up to the design pressures indicated in Section 2.2.1.

.3 The ductwork shall be provided with sample ports at the locations indicated on the Contract Drawings.

.4 Materials:

.1 Resin System: Premium corrosion resistance, fire retardant vinyl ester, or approved equivalent.

.2 Liner Resin: Premium grade and corrosion resistant.

.3 Flame Spread Index: ASTM E84, less than 25; fire retardant additives used only in structural layer.

.4 Color: Duct shall be white. Submit sample for approval prior to manufacture.

.5 Reinforcement:

.1 Veil: Chemical surfacing mat, polyester fabric, with finish and binder compatible with layup resin.

.2 Corrosion Barrier: Resin rich interior surface of nominal 2.5 to 3.0 mm thick, using chopped strand mat backing the veil. Use no additive in corrosion barrier.

.6 FRP Ductwork Fabrication:

.1 Physical Properties: Meet or exceed the requirements of ASTM D3982.

.2 Squareness of ends, fittings, elbows, and joints shall meet or exceed the requirements of ASTM D3982.

.3 Butt joints shall be the method of joining duct sections, unless otherwise indicated on the Contract Drawings.

.4 Flanges for duct-to-duct and duct-to-equipment connections: Meet or exceed the requirements of ASTM D3982, ANSI B16.5, ANSI B16.47.

.5 The Contractor shall ensure suitable flange-to-flange mating for duct-to-equipment connections.

.6 Gaskets: EPDM, 3 mm thick, full face, Durometer – A50 to A60.

.7 Flange bolts and nuts: Type 316 stainless steel bolts, ASTM A320 Grade B8M, ASTM A194 Grade 8M hex head nuts and lock washers, shall be used on flanged joints.

.8 Duct thickness: Minimum ductwork thickness shall be 7.5 mm.

.9 Transitions: Transitions between differing duct dimensions shall be provided by the Contractor for the locations shown on the Contract Drawings. Joints shall be butt joints unless otherwise indicated on the Contract Drawings as a flange connection.

.7 The Contractor shall supply and install insulation and aluminum wrapping for all outdoor ductwork as shown on the Contract Drawings and as specified in Section 2.5.

2.5 Duct Insulation

.1 Minimum 3.87 lb/ft^3 density, semi rigid glass fiber insulation, 50 mm thick supported longitudinally, arranged with staggered joints, and banded to the duct on 300 mm centers with 12.5 mm wide stainless steel bands.

.2 Insulation to be jacketed with aluminum childers "lock-on" or equivalent 0.7 mm thick stucco embossed aluminum jacket material in accordance with ASTM B209, factory cut to size and, complete with moisture barrier and continuous modified Pittsburgh z-lock, and butt straps to weatherproof the end to end joints. Fittings are to be two-piece epoxy coated pressed aluminum with locking edge.

2.6 Expansion Joints

.1 Expansion joints shall be provided for equipment to duct connections as shown in the Contract Drawings. Expansion joints shall be secured to the duct and the equipment outlet stub connectors with flange connections in order to provide a water and gas tight construction.

.2 The expansion joints shall be sufficiently flexible to prevent the transmission of any discernible vibration from the equipment to the ductwork and allow for thermal expansion.

.3 The manufacturer is to provide expansion joint flange details to the Contractor for coordination of ductwork to expansion joint attachment.

.4 All equipment supplied shall be suitable for continuous operation in the conditions specified in Section 2.2.1.

.5 Expansion joint installation shall be air and watertight up to the process pressure conditions specified in Section 2.2.1.

2.7 Butterfly Dampers

.1 Butterfly dampers: All round dampers shall be exposed to a humid, corrosive atmosphere as described is Section 2.2.1, and all dampers shall be constructed of fiberglass reinforced plastic. Butterfly dampers are to be supplied where indicated on the Contract Drawings.

.2 Where control is indicated as being motorized on the Contract Drawings, the dampers shall be equipped with actuators, positioners, and local OPEN/CLOSE push button controls. All dampers shall have a manual open and close mechanism and/or override.

.3 Dampers shall have the ability to be locked in place for the purposes of balancing and shall be equipped with a robust handle or chain and wheel positioner assembly for easy access by facility personnel.

.4 All motorized dampers shall be rated for operation in a Class 1, Division 2, Group D environment as per NFPA 820.

.1 Acceptable Actuator Manufacturers:

.1 Rotork.

.2 Auma.

.5 Dampers:

.1 Single blade type, complete with channel type frame, close fitting axle, and bearings.

.2 Same inside diameter as connecting ductwork.

.3 Axles not less than 25 mm in diameter and shall be continuous through the damper.

.4 Isolation dampers shall be furnished with full circumference molded in blade stop.

.5 Flanges for duct connections to match ANSI B16.5 and ANSI B16.47.

.6 Design Requirements:

.1 Frame and seat leakage: No greater than 1% for isolation and 5% for balancing of design airflow rate in Section 2.2.1.

.7 Materials:

.1 Materials, resin, and flame spread shall be the same as FRP ductwork.

.8 Construction:

.1 Frames: FRP with resin as described herein.

.2 Blades: FRP with resin as described herein. Blade thickness and stiffeners shall be designed to meet the design conditions required.

.3 Axles: Continuous FRP rod with resin as described herein. Axle to extend 150 mm beyond frame.

.4 Bearings: Moulded polytetrafluoroethylene (PTFE).

.5 Blade Stops: FRP with resin as described herein.

.6 Blade Seals: Polychloroprene.

.7 Shaft Seals: Polychloroprene.

3. EXECUTION

3.1 General Installation

.1 Cut, fit, and install in accordance with the duct manufacturer’s instructions and the Contract Drawings.

.2 Ductwork shall be free of vibration while in operation.

.3 Install plumb, straight, and in proper alignment.

.4 Anti-seize thread compound shall be applied to all nuts and bolts.

.5 Flange bolts shall be tightened to torque values specified by the manufacturer. Install gaskets at each flange connection and flat washer under each nut and bolt head.

.6 Install ductwork with a minimum clearance of 25 mm, plus allowance for the insulation and wrapping thickness.

.7 All horizontal ductwork shall be installed with the slopes indicated on the Contract Drawings to facilitate drainage to the nearest drain or process connection.

3.2 Start-up

.1 Provide services of factory-trained Service Technician, specifically trained on type of equipment specified:

.1 Service Technician must be present on site for all items listed below. Person-day requirements listed are exclusive of travel time, and do not relieve Contractor of the obligation to place equipment in operation as specified.

.2 Comply with requirements for checkout, start-up, and testing in Section 01 91 13.

.3 Physical Checkout and Field Testing (Functional Completion Testing): Inspect grouting, location of anchor bolts; setting, leveling, alignment, field erection; coordination of piping, electrical and miscellaneous utility connections; certify proper installation:

.1 2 person-days.

.4 Startup: Calibrate, check alignment and perform a functional test with water or process fluid. Tests to include all items specified.

.1 1 person-day.

.5 Commissioning: Field performance test equipment specified.

.1 2 person-days.

3.3 Field Testing

.1 Comply with requirements of Section 01 91 31.

.2 Field test ductwork after installation and before concealment or burying, with air test to a pressure of -4.5 kPa. for a period of two (2) hours. Testing must demonstrate a pressure drop of no more than 5% of the test pressure over the course of the test period. Leaks shall be corrected, and duct retested by the Contractor until no further leaks occur.

3.4 Cleaning

.1 Blow ductwork clean continuously for a minimum of forty-eight (48) hours at the ductwork branch airflow rates shown on the Contract Drawing P&IDs.

.2 Contractor shall protect debris from entering the odour control system.

3.5 Closeout Activities

.1 Provide in accordance with Section 01 78 00.

END OF SECTION

GENERAL PROCESS PROVISIONS

1. GENERAL

1.1 Requirements

.1 Provide complete, fully tested and operational process systems to meet requirements described herein and in complete accord with applicable codes and ordinances.

.2 This Section is to be read in conjunction with the provided process and instrumentation drawings and general arrangement drawings.

.3 Construction Contract Documents and Drawings of this Division are diagrammatic and approximately to scale unless detailed otherwise. They establish scope, material and installation quality and are not detailed installation instructions.

.4 Follow Manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Bid Documents.

.5 Install equipment generally in locations and routes shown, close to building structure with minimum interference with other services or free space. Remove and replace improperly installed equipment to satisfaction of the Contract Administrator at no extra cost.

.6 Install equipment to provide access and ease of maintenance.

.7 The Construction Contractor must supply and install the required identification, labeling or signage for each pipe, valve and piece of equipment, in accordance with the Best Practice Guideline for Occupational Safety and Health (OSHA) Pipes and Signage. In addition, the Construction Contractor must be familiar with and follow the AECL Procedure WL-510445-PRO-667 for OSH Safety Signage Procedures.

.8 Contractor to coordinate for all process mechanical equipment power requirements and revisions to electrical distribution system. Acceptable voltages for equipment are 600V / 208V / 120V and 24V. If any actuator requires more than a 15 Amp breaker, then it shall be provided at the next highest voltage, up to a maximum of 600 V.

1.2 Discrepancies and Omissions

.1 These Specifications shall be considered as an integral part of the Drawings, which accompany them, and neither the Drawings nor Specifications shall be used alone. Any items or subject omitted from one but which is mentioned and/or indicated in the other shall be considered as properly and sufficiently specified and shall therefore be provided.

1.3 Transportation and Hoisting

.1 Assume responsibility for transportation, hoisting, warehousing, and demurrage for all equipment and materials to be furnished and installed under this Division.

1.4 Definitions and Interpretations

.1 Where the term "Provide" is used herein, it shall be understood to include labour, materials, and services necessary to supply, install and make functional the items or Work referenced.

.2 Where the term "Instructions" or "As Instructed" or "Where Instructed", etc. is used herein, it shall be understood to mean as instructed in writing by the Contract Administrator.

.3 Where the term "Listed" is used herein, it shall be understood to mean that the materials or equipment have been tested in accordance with applicable standards and methods, have been approved and listed for the intended use by a testing authority which itself has been approved by the Authorities Having Jurisdiction.

.4 Where the term "Approved", "Approval", etc. is used herein, it shall be understood to mean approved by Authorities Having Jurisdiction as conforming to Codes, Standards, By-Laws, etc.

.5 Where the term "Acceptable" or "Acceptance", etc. is used herein, it shall be understood to mean acceptable to the Contract Administrator as conforming to the requirements of the Construction Contract Documents.

.6 Where the term "Submit for Review" is used herein, it shall be understood to mean submit in writing to the Contract Administrator.

.7 Where the term "Subject to Review" etc. is used herein, it shall be understood to mean Work shall be laid out for review by the Contract Administrator. No Work shall proceed until written instructions have been obtained from the Contract Administrator. Submit further information, Shop Drawings, samples, etc. as specified and/or as may be reasonably requested by the Contract Administrator.

.8 Where the term "Accessible" is used herein, it shall be understood to mean readily approachable by person or tools as required and where obstacles may be removed and replaced without cutting or breaking out materials.

.9 Where working pressure or pressure ratings are specified or shown on the Drawings for valves, piping, fittings, equipment, etc., these items shall be suitable for operating at specified pressures and corresponding temperature unless noted otherwise.

.10 I/Os from stand-alone control panels shall be interfaced with Main Plant System via hardwired as shown on P&IDs. In addition to hardwired I/Os, provide Modbus TCP/IP link for additional monitoring status to Main Plant System. If this is not available, notify the Contract Administrator immediately and revise I/Os to hardwired interface to Main Plant System.

1.5 Shop Drawings

.1 Refer to Section 01 33 00 for the general requirements for Shop Drawings.

.2 For specific requirements for Shop Drawings for various pieces of equipment, refer to the relevant specific Sections describing the equipment.

1.6 Coordination

.1 Coordinate with other Divisions the location of openings, housekeeping pads and anchor bolts.

.2 Coordinate the connection of the services of other Divisions to the equipment and material supplied under this Division.

1.7 Minor Changes

.1 Equipment and materials shall be located and arranged generally as shown on the Drawings. However, minor changes may be required to suit the precise requirements of the actual equipment or materials supplied, or to avoid conflict between services.

.2 Prior to the installation of the relevant equipment or materials, the Construction Contractor shall advise the Contract Administrator of the requirement for any minor changes (including box-outs and coring) and shall undertake such minor changes as instructed by the Contract Administrator. Such changes shall be undertaken at no extra cost except where the connection or arrangement is modified in length, or alignment, or position, by more than 1 m; or if the change involves the addition of more than two (2) fittings greater than 150 mm in diameter.

.3 The building envelope layout and structural components cannot be modified.

1.8 Cutting and Patching

.1 Provide holes and sleeves, cutting and fitting required for mechanical Work. Relocate improperly located holes and sleeves.

.2 Drill for expansion bolts, hanger rods, brackets, and supports.

.3 Obtain written approval from the Contract Administrator before cutting or burning structural members.

.4 Patch building where damaged from equipment installation, improperly located holes etc. Use matching materials as specified in the respective Section.

1.9 Substantial Performance and Construction Completion

.1 Prior to Substantial Performance, provide a complete list of items which are deficient at the time of the Substantial Performance inspection.

.2 Perform the following items prior to Substantial Performance inspection:

.1 Make systems capable of operation with alarm controls functional and automatic controls in operation generally, but not necessarily finally calibrated.

.2 Make necessary tests on equipment including those required by authorities. Obtain certificates of approval.

.3 Complete valve tagging and identify equipment. Paint equipment, piping and install escutcheon.

.4 Lubricate equipment in accordance with the Manufacturer's data.

.5 Mail warranty forms to Manufacturer. Provide copy of original warranty for equipment which has Maintenance Period longer than one (1) year.

.6 Submit Operation and Maintenance Manuals in accordance with Section 01 33 00.

.3 Prior to Construction Completion Inspection, provide declaration in writing that deficiencies noted at time of Substantial Performance Inspection have been corrected and the following items completed prior to the Construction Completion Inspection:

.1 Complete final calibration of controls.

.4 The Construction Contractor shall provide qualified personnel in appropriate numbers to operate the facility until Substantial Performance is declared.

1.10 Equipment Protection and Clean-Up

.1 Protect equipment and materials in storage on Site during and after installation until final acceptance. Leave factory covers in place. Take special precautions to prevent entry of foreign material into working parts of piping and duct systems.

.2 Protect equipment with polyethylene covers and crates.

.3 Thoroughly clean both existing and new piping, ducts and equipment of dirt, cuttings and other foreign substances.

.4 Ensure that existing equipment is carefully dismantled and not damaged or lost. Do not reuse existing materials and equipment unless specifically indicated.

1.11 Temporary Usage

.1 Usage by the City of any process device, apparatus, machinery or equipment prior to Construction Completion being issued is not to be construed as acceptance.

1.12 Acceptable Products and Manufacturers

.1 Wherever possible, all equipment and related coatings, lubricants, etc. shall be NSF/ANSI Standard 61 approved.

1.13 Spare Parts and Special Tools

.1 If spare parts or special tools are to be provided with any equipment specified, the specific parts or tools will be listed in the relevant Specification Section and are to be supplied with the equipment.

.2 Where the operation of the equipment for two (2) years would require that some specific spare parts may be required, but are not listed in the Specification, the Construction Contractor shall so inform the Contract Administrator. Costs, delivery periods, and any other information relevant to the procurement of the identified spare parts shall be identified.

.3 Where some specific special tools are required for the maintenance and/or operation of a specific item of equipment, but are not listed, the Construction Contractor shall inform the Contract Administrator. Costs, delivery periods, and any other information relevant to the procurement of the identified special tools shall be provided.

.4 This clause does not relieve the Construction Contractor of the responsibility to provide, at no cost, any spare parts required during the maintenance period to repair malfunctioning or failed equipment. At the end of the maintenance period, the spare parts inventory shall be replenished.

1.14 Abbreviations

.1 ABMA - American Bearing Manufacturers Association.

.2 AISI - American Iron and Steel Institute.

.3 ANSI - American National Standards Institute.

.4 API - American Petroleum Institute.

.5 ASME - American Society of Mechanical Consultants.

.6 ASTM - ASTM International (formerly American Society for Testing and Materials).

.7 AWS - American Welding Society.

.8 AWWA - American Water Works Association.

.9 CGA - Canadian Gas Association.

.10 CGSB - Canadian General Standards Board.

.11 CISPI - Cast Iron Soil Pipe Institute.

.12 CPC - Canadian Plumbing Code.

.13 CSA - Canadian Standards Association.

.14 EJMA - Expansion Joint Manufacturer's Association.

.15 MIL - Military Standard.

.16 MSS - Manufacturers Standardization Society of the Valve and Fittings Industry.

.17 NACE - NACE International (formerly National Association of Corrosion Consultants).

.18 NSF - NSF International (formerly National Sanitation Foundation).

.19 SSPC - Society for Protective Coatings.

2. PRODUCTS

2.1 Spare Parts

.1 Spare parts are to be supplied by the Construction Contractor as required in the various Specification Sections. The lists in these Sections are intended to include all parts which normally would be required within a single year for normal preventative maintenance and where fabrication requirements for special parts would delay delivery and could keep an item of equipment out of service for an extended period.

.2 Any special spare parts not listed shall be identified by the Construction Contractor, with a price list.

.3 In addition, the Construction Contractor shall provide a list of all spare parts, not including lubricants, which normally would be required through the first five (5) years of operation. Provide prices for each part, guaranteed for six (6) months.

.4 The Construction Contractor shall be responsible to replenish the spare parts used in the initial year of operation at the end of the maintenance period for the related item(s) of equipment.

2.2 Flanges and Pipe Threads

.1 Provide flanges on cast iron equipment and appurtenances that conform in dimension and drilling to ANSI B16.1, Class 125 and flanges on steel equipment and appurtenances that conform in dimension and drilling to ANSI B16.5, Class 150 unless otherwise specified.

.2 Provide pipe threads that conform in dimension and limits of size to ANSI B1.1, coarse thread series, Class 2 fit.

.3 Provide flange assembly bolts that are heavy pattern, hexagonal head, carbon steel machine bolts with heavy pattern, hot pressed, hexagonal nuts conforming to ANSI B18.2.1 and B18.2.2. Provide threads that conform to Unified Screw Threads, Standard Coarse Thread Series, Class 2A and 2B, ANSI B1.1.

2.3 Guards

.1 On moving parts, provide sheet steel guards in accordance with workplace safety regulations. Fabricate of 14-gauge steel and galvanize after construction.

.2 Guards shall be removable to facilitate maintenance of moving parts.

3. EXECUTION

3.1 Training

.1 Scheduling of training is to be arranged with the Contract Administrator.

.2 The training will be by the Manufacturer's Representative and/or the Installer Trades and will include maintenance procedures, troubleshooting, and repair procedures for all electrical and mechanical components. Construction Contractor to assist and coordinate operator training.

END OF SECTION