PART E

SPECIFICATIONS

Part 1 General

1.1 SCOPE OF WORK SUMMARY

.1 Scope of work includes materials and installation requirements for

1.2 WORK SEQUENCE

.1 Construct Work in stages to accommodate The City's continued use of premises during construction.

.2 Maintain fire access/control.

1.3 CONTRACTOR'S USE OF PREMISES

.1 Limit use of premises for storage, for Work, for access, to allow:

.1 City occupancy.

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

.3 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.

.4 Remove or alter existing work to prevent injury or damage to portions of existing work which remain.

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

.6 At completion of operations condition of existing work: equal to or better than that which existed before new work started.

1.4 OCCUPANCY

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

.2 Co-operate with the City in scheduling operations to minimize conflict and to facilitate the City usage.

1.5 EXISTING SERVICES

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

.2 Where Work involves breaking into or connecting to existing services, give 2 weeks notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to City operations.

.3 Provide alternative routes for personnel.

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

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

.6 Provide temporary services when directed by Contract Administrator to maintain critical building systems.

.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.

1.6 DOCUMENTS REQUIRED

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

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

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

Part 1 General

1.1 SCOPE OF WORK

.1 Contract Administrator shall schedule and coordinate the following meetings with the Contractor, as required:

- .1 Pre-construction meeting.
- .2 Bi-weekly construction progress meetings throughout the presence on site until Total Performance. Allow for weekly meeting for the first two months of the project.
- .3 Commissioning Meetings prior to and during all commissioning activities.

.2 The purpose of these meetings is to review personnel assignments, responsibilities, administrative and procedural requirements and to obtain updates on construction and commissioning progress.

.3 The Contract Administrator shall chair the meetings and take minutes. The minutes shall be distributed within 3 working days from the date of the meeting.

.4 Contractor shall also coordinate location, attendees, and agenda with the Contract Administrator.

.5 The bi-weekly construction meetings shall be attended by the Contractor's Project Manager, Site Superintendent, Subcontractor leads and any technical experts that are required to communicate the Construction and overall management of activities to the Contract Administrator.

1.2 ADMINISTRATIVE

.1 Contract Administrator shall,

- .1 Schedule and administer project meetings throughout the progress of the Work.
- .2 Prepare agenda for meetings.
- .3 Distribute written notice of each meeting five working days in advance of meeting date to Contract Administrator.
- .4 Provide physical space and make arrangements for meetings.
- .5 Preside at meetings.
- .6 Record the meeting minutes. Include significant proceedings and decisions. Identify actions by parties.
- .7 Distribute copies of minutes within three working days after meetings and transmit to meeting participants and, affected parties not in attendance.
- .8 Allow provisions for some City staff to attend the meetings virtually via MS Teams.

.2 The Contractor shall ensure that representatives of Contractor, Subcontractors and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

1.3 PRECONSTRUCTION MEETING

.1 Within 15 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.

.2 Contract Administrator, Contractor, major Subcontractors, field inspectors and supervisors will be in attendance.

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

.4 Agenda to include:

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

.2 Schedule of Work: in accordance with 01 32 16.06- Construction Progress Schedule - Critical Path Method (CPM).

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

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

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

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

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

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

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

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

.11 Appointment of inspection and testing agencies or firms.

.12 Insurances, transcript of policies.

1.4 PROGRESS MEETINGS

.1 During course of Work and bi-weekly.

.2 Contractor, major Subcontractors involved in Work and Contract Administrator are to be in attendance.

.3 Notify parties minimum 5 working days prior to the meeting.

.4 Record minutes of meetings and circulate to attending parties and affected parties not in attendance within 3 working days by Contract Administrator.

.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 affect on construction schedule and on completion date.

.12 Other business.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SCOPE OF WORK

.1 The scope of work includes the following as detailed herein:

.1 Project master schedule

.1 Include key shutdown dates

.2 Project detail schedule, updated bi-weekly, with minimum four (4) week look ahead.

1.2 REFERENCE STANDARDS

.1 Project Management Institute (PMI Standards)

.1 A Guide to the Project Management Body of Knowledge (PMBOK Guide) – Latest Edition.

.2 Practice Standard for Scheduling - 2011.

1.3 DEFINITIONS

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

.2 Bar Chart (Gantt chart): graphic display of schedule-related information. In typical bar chart, activities or other Project elements are listed down left side of chart, dates are shown across top, and activity durations are shown as date-placed horizontal bars.

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

.4 Cash Flow: projection of progress payment requests based on cash loaded construction schedule.

.5 Completion Milestones: they are firstly Substantial Completion and secondly Total Performance Certificate.

.6 Constraint: applicable restriction or limitation, either internal or external to project, that will affect performance of Project. Factors that affect activities can be scheduled.

.7 Control: process of comparing actual performance with planned performance, analyzing variances, evaluating possible alternatives, and taking appropriate corrective action as needed.

.8 Critical Activity: any activity on a critical path.

.1 Most commonly determined by using critical path method.

.9 Critical Path: sequence of activities that determines duration of Project. Generally, it is the longest path through Project.

.1 Usually defined as those activities with float less than or equal to specified value, often zero.

.10 Critical Path Method (CPM): network analysis technique used to determine the amount of scheduling flexibility (amount of float) on various logical network paths in Project schedule network, and to determine the minimum total Project duration.

.11 Data Date: date through which project status and progress were last determined and reported for analyses, such as scheduling and performance measurements.

.12 Duration: total number of work periods (not including holidays or other non-working periods) required to complete activity or another Project element.

.1 Usually expressed as workdays or work weeks.

.13 Early Finish Date: in critical path method, earliest possible point in time on which uncompleted portions of activity (or Project) can finish, based on network logic and schedule constraints.

.1 Early finish dates can change as Project progresses and changes are made to Project plan.

.14 Early Start Date: in critical path method, earliest possible point in time on which uncompleted portions of activity (or Project) can start, based on network logic and schedule constraints.

.1 Early start dates can change as Project progresses and changes are made to Project Plan.

.15 Finish Date: point in time associated with activity's completion.

.1 Usually qualified by one of following: actual, planned, estimated, scheduled, early, late, baseline, target, or current.

.16 Float: amount of time that activity may be delayed from its early start without delaying Project finish date.

.1 This resource is available to both Contract Administrator and Contractor.

.17 Impact Analysis: schedule analysis technique that adds a modeled delay to an accepted construction schedule to determined possible outcome of that delay on project completion.

.18 Lag: modification of logical relationship that directs delay in successor activity.

.19 Late Finish Date (LF): in critical path method, latest possible point in time that activity may be completed without delaying specified milestone (usually Project finish date).

.20 Late Start Date (LS): in critical path method, latest possible point in time that activity may begin without delaying specified milestone (usually Project finish date).

.21 Lead: modification of logical relationship that allows acceleration of successor task.

.22 Logic Diagram: see Project network diagram.

.23 Master Schedule: summary-level schedule that identifies major deliverable; work breakdown structure and key milestones.

.24 Milestone: significant point or event in Project, usually completion of major deliverable.

.25 Monitoring: capture, analysis, and reporting of Project performance, usually as compared to plan.

.26 Non-Critical Activities: activities which when delayed, do not affect specified Contract duration.

.27 Project Control System: fully computerized system utilizing commercially available software packages.

.28 Project Network Diagram: schematic display of logical relationships of Project activities.

.1 Always drawn from left to right to reflect Project chronology.

.29 Project Plan: formal, approved document used to guide both Project execution and Project control.

.1 Primary uses of Project plan are to document planning assumptions and decisions, facilitate communication among stakeholders, and document approved scope, cost, and schedule baselines.

.2 Project plan may be summary or detailed.

.30 Project Planning: development and maintenance of Project Plan.

.31 Project Planning, Monitoring and Control System: overall system operated to enable monitoring of Project Work in relation to established milestones.

.32 Project Schedule: planned dates for performing activities and planned dates for meeting milestones.

.33 Quantified days duration: working days based on 5-day work week, discounting statutory holidays.

.34 Risk: uncertain event or condition that, if it occurs, has positive or negative effect on Project's objectives.

.35 Start Date: point in time associated with activity's start, usually qualified by one of following: actual, planned, estimated, scheduled, early, late, target, baseline, or current.

.36 Work Breakdown Structure (WBS): deliverable-oriented hierarchical decomposition of Work to be executed by contractor to accomplish project objectives and create required deliverables. It organizes and defines total scope of Project. Each descending level represents an increasingly detailed definition of Project Work. WBS is decomposed into Work packages.

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Project Meeting:

.1 Participate in regular project progress meetings with Contract Administrator specifically intended to discuss update of detailed schedule and contract changes.

.2 Scheduling:

.1 Planning: ensure that planning process is iterative and results in generally top-down processing with more detail being developed as planning progresses, and decisions concerning options and alternatives are made.

.2 Ensure project schedule efficiencies through monitoring of Project in detail to ensure integrity of Critical Path, by comparing actual completions of individual activities with their scheduled completions, and review progress of activities that has started but are not yet completed.

.3 Monitor sufficiently often so that causes of delays can immediately be identified and removed.

.3 Project monitoring and reporting:

.1 Keep team aware of changes to schedule, and possible consequences as project progresses.

.2 Use narrative reports to provide advice on seriousness of difficulties and measures to overcome them.

.3 Begin narrative reporting with statement on general status of Project followed by summarization of delays, potential problems, corrective measures and Project status criticality.

.4 Critical Path Method (CPM) Requirements:

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

.2 Revise Master Schedule and Detail Schedule deemed impractical by Contract Administrator and resubmit for approval.

.3 Change to Contract Duration:

.1 Acceptance of Master Schedule and Detail Schedule showing scheduled Contract duration shorter than specified Contract duration does not constitute change to Contract.

.2 Duration of Contract may only be changed through bilateral Agreement.

.4 Consider Master Schedule and Detail Schedule deemed practical by Contract Administrator, showing Work completed in less than specified Contract duration, to have float.

.5 First Milestone on Master Schedule and Detail Schedule will identify start Milestone with an "ES" constraint date equal to Award of Contract date.

.6 Calculate dates for completion milestones from Plan and Schedule using specified time periods for Contract.

.7 Substantial Completion with "LF" constraint equal to calculated date.

.8 Calculations on updates to be such that if early finish of Substantial Completion Certificate falls later than specified Contract duration then float calculation to reflect negative float.

.9 Delays to non-critical activities, those with float may not be basis for time extension.

.10 Do not use float suppression techniques such as preferential sequencing, imposed dates other than required by Contract, software constraints, extended activity times, and special lead/lag logic restraints.

.11 Allow for and show Master Plan and Detail Schedule adverse weather conditions normally anticipated.

.1 Specified Contract duration has been predicated assuming normal amount of adverse weather conditions.

.12 Provide necessary crews and manpower to meet schedule requirements for performing Work within specified Contract duration.

.1 Simultaneous use of multiple crews on multiple fronts on multiple critical paths may be required.

.13 Arrange participation on and off site of subcontractors and suppliers, as required by Contract Administrator, for purpose of network planning, scheduling, updating and progress monitoring.

.1 Approvals by Contract Administrator of original networks and revisions do not relieve Contractor from duties and responsibilities required by Contract.

.14 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Substantial Completion Certificate and Total Performance Certificate as defined times of completion are of essence of this contract.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit to Contract Administrator Project Control System for planning, scheduling, monitoring and reporting of project progress.

.3 Submit Project Control System to Contract Administrator for approval.

.4 Include costs for execution, preparation and reproduction of schedule submittals in bid documents.

.5 Submit letter ensuring that schedule has been prepared in co-ordination with major sub-contractors.

.6 Refer to article "PROGRESS MONITORING AND REPORTING" of this specification Section for frequency of Project control system submittals.

.7 Submit impact analysis of schedule for changes that result in extension of contract duration.

.1 Include draft schedule update and report as outlined in article "PROGRESS MONITORING AND REPORTING".

.8 Submit Project planning, monitoring and control system data as part of initial schedule submission and monthly status reporting in following form.

.1 Master Schedule Bar Chart.

.2 Construction Detail schedule Bar Chart.

.3 Listing of project activities including milestones and logical connectors, networks (sub-networks) from Project start to end. Sort activities by activity identification number and accompany with descriptions. List early and late start and finish dates together with durations, codes and float.

.4 Criticality report listing activities and milestones with zero days total float used as first sort for ready identification of critical paths through entire project. List early and late starts and finishes dates, together with durations, codes and float for critical activities.

.5 Progress report in early start sequence, listing for each trade, activities underway, due to start, or finished within 1 months from monthly update date. List activity identification number, description and duration. Provide columns for entry of actual start and finish dates, duration remaining and remarks concerning action required.

1.6 QUALITY ASSURANCE

.1 Use experienced personnel, fully qualified in planning and scheduling to provide services from start of construction to Final Certificate, including Commissioning.

1.7 WORK BREAKDOWN STRUCTURE (WBS)

.1 Prepare construction Work Breakdown Structure (WBS) within two weeks

.1 Develop WBS through at least five levels: project, stage, element, sub-element and work package.

1.8 PROJECT MILESTONES

.1 Mandatory and recommended project milestones form targets for both Master Schedule and Detail Schedule of CPM construction network system.

1.9 MASTER SCHEDULE

.1 Structure and base CPM construction networks system on WBS coding in order to ensure consistency throughout Project.

.2 Prepare comprehensive construction Master Schedule (CPM logic diagram) and dependent Cash Flow Projection within two weeks.

.1 Master Schedule will be used as baseline.

.1 Revise baseline as conditions dictate and as required by Contract Administrator.

.3 Reconcile revisions to Master Schedule and Cash Flow Projections with previous baseline to provide continuous audit trail.

.4 Initial and subsequent Master Schedule will include:

.1 Electronic file containing schedule and cash flow information, clearly labelled with data date, specific update, and person responsible for update.

.2 Bar chart identifying coding, activity durations, early/late and start/finish dates, total float, completion as percentile, current status and budget amounts.

.3 Network diagram showing coding, activity sequencing (logic), total float, early/late dates, current status and durations.

.4 Actual/projected monthly cash flow: expressed monthly and shown in both graphical and numerical form.

1.10 DETAIL SCHEDULE

.1 Provide detailed project schedule (CPM logic diagram) within 7 days of start of Work and bi-weekly updates thereafter until Total Performance.

.2 Detail CPM schedule to cover in detail minimum period of one month.

.1 Show remaining activities for CPM construction network system up to Final Certificate and develop complete detail as project progresses.

.2 Detail activities completely and comprehensively throughout duration of project.

.3 Relate Detail Schedule activities to basic activities and milestones developed and approved in Master Schedule.

.4 Clearly show sequence and interdependence of construction activities and indicate:

.1 Start and completion of all items of Work, their major components, and interim milestone completion dates.

.2 Activities for procurement, delivery, installation and completion of each major piece of equipment, materials and other supplies, including:

.1 Time for submittals, resubmittals and review.

.2 Time for fabrication and delivery of manufactured products for Work.

.3 Interdependence of procurement and construction activities.

.3 Include sufficient detail to assure adequate planning and execution of Work. Activities should generally range in duration from 3 to 15 workdays each.

.5 Provide level of detail for project activities such that sequence and interdependency of Contract tasks are demonstrated and allow co-ordination and control of project activities. Show continuous flow from left to right.

.6 Ensure activities with no float are calculated and clearly indicated on logical CPM construction network system as being, whenever possible, continuous series of activities throughout length of Project to form "Critical Path". Increased number of critical activities is seen as indication of increased risk.

.7 Insert Change Orders in appropriate and logical location of Detail Schedule. After analysis, clearly state and report to Contract Administrator for review effects created by insertion of new Change Order.

1.11 REVIEW OF THE CONSTRUCTION DETAIL SCHEDULE

.1 Allow 5 work days for review by Contract Administrator of proposed construction Detail Schedule.

.2 Upon receipt of reviewed Detail Schedule make necessary revisions and resubmit to Contract Administrator for review within 5 work days.

.3 Promptly provide additional information to validate practicability of Detail Schedule as required by Contract Administrator.

.4 Submittal of Detail Schedule indicates that it meets Contract requirements and will be executed generally in sequence.

1.12 COMPLIANCE WITH DETAIL SCHEDULE

.1 Comply with reviewed Detail Schedule.

.2 Proceed with significant changes and deviations from scheduled sequence of activities that cause delay, only after written receipt of approval by Contract Administrator.

.3 Identify activities that are behind schedule and causing delay. Provide measures to regain slippage.

.1 Corrective measures may include:

.1 Increase of personnel on site for effected activities or work package.

.2 Increase in equipment.

.3 Overtime work and/or Additional work shifts.

.4 Submit to Contract Administrator justification, project schedule data and supporting evidence for approval of extension to Contract completion date or interim milestone date when required. Include as part of supporting evidence:

.1 Written submission of proof of delay based on revised activity logic, duration and costs, showing time impact analysis illustrating influence of each change or delay relative to approved contract schedule.

.2 Prepared schedule indicating how change will be incorporated into the overall logic diagram. Demonstrate perceived impact based on date of occurrence of change and include status of construction at that time.

.3 Other supporting evidence requested by Contract Administrator.

.4 Do not assume approval of Contract extension prior to receipt of written approval from Contract Administrator.

.5 In event of Contract extension, display in Detail Schedule that scheduled float time available for work involved has been used in full without jeopardizing earned float.

.1 Contract Administrator will determine and advise Contractor number of allowable days for extension of Contract based on project schedule updates for period in question, and other factual information.

.2 Construction delays affecting project schedule will not constitute justification for extension of contract completion date.

1.13 PROGRESS MONITORING AND REPORTING

.1 On ongoing basis, Detail Schedule on job site must show "Progress to Date". Arrange participation on and off site of subcontractors and suppliers, as, and when necessary, for purpose of network planning, scheduling, updating and progress monitoring. Inspect Work with Contract Administrator at least once monthly to establish progress on each current activity shown on applicable networks.

.2 Update and reissue project Work Breakdown Structure and relevant coding structures as project develops and changes.

.3 Perform Detail Schedule update bi-weekly with status dated (Data Date) on last working day of month. Update to reflect activities completed to date, activities in progress, logic and duration changes.

.4 Do not automatically update actual start and finish dates by using default mechanisms found in project management software.

.5 Submit to Contract Administrator copies of updated Detail Schedule.

.6 Requirements for monthly progress monitoring and reporting are basis for progress payment request.

.7 Submit bi-weekly written report based on Detail Schedule, showing Work to date performed, comparing Work progress to planned, and presenting current forecasts. Report must summarize progress, defining problem areas and anticipated delays with respect to Work schedule, and critical paths. Explain alternatives for possible schedule recovery to mitigate any potential delay. Include in report:

.1 Description of progress made.

.2 Pending items and status of: permits, possible time extensions, shop drawings, requests for information (RFI), proposed change notices / change orders.

.3 Status of Contract completion date and milestones.

.4 Current and anticipated problem areas, potential delays and corrective measures.

.5 Review of progress and status of Critical Path activities.

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE

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

.2 Do not proceed with Work affected by submittal until review is complete.

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

.4 Where items or information is not produced in SI Metric units converted values are acceptable. Review submittals prior to submission to Contract Administrator. This review represents that necessary requirement have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.

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

.6 Verify field measurements and affected adjacent Work are co-ordinated.

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

.8 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Contract Administrator review.

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

1.2 SHOP DRAWINGS AND PRODUCT DATA

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

.2 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

.3 Allow 14 days for Contract Administrator's review of each submission.

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

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

.6 Accompany submissions with transmittal letter, containing:

.1 Date.

.2 Project title and number.

.3 Contractor's name and address.

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

.5 Other pertinent data.

.7 Submissions include:

.1 Date and revision dates.

.2 Project title and number.

.3 Name and address of:

- Subcontractor.
- Supplier.
- Manufacturer.

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

.5 Details of appropriate portions of Work as applicable:

- Fabrication.
- Layout, showing dimensions, including identified field dimensions, and clearances.
- Setting or erection details.
- Capacities.
- Performance characteristics.
- Standards.
- Operating weight.
- Wiring diagrams.
- Single line and schematic diagrams.
- Relationship to adjacent Work.

.8 After Contract Administrator's review, distribute copies.

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

.10 Submit electronic (PDF format) copies of test reports for requirements requested in specification Sections and as requested by Contract Administrator.

.1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.

.11 Submit electronic (PDF format) copies of certificates for requirements requested in specification Sections and as requested by Contract Administrator.

.1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.

.2 Certificates must be dated after award of project contract complete with project name.

.12 Submit one electronic PDF copy and 3 hard copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Contract Administrator.

.13 Delete information not applicable to project.

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

.15 If upon review by Contract Administrator, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

1.3 PHOTOGRAPHIC DOCUMENTATION

.1 Submit electronic copy of colour digital photography in jpg format, standard resolution monthly with progress statement and as directed by Contract Administrator.

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

.3 Frequency of photographic documentation: weekly.

.1 Upon completion of: excavation, foundation, framing and services before concealment, and as directed by Contract Administrator.

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 SCOPE OF WORK

.1 Scope of Work shall include:

.1 Preparation and execution of the site-specific Health and Safety Plan.

1.2 REFERENCE STANDARDS

.1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations

.2 Province of Manitoba

.1 The Workers Compensation Act RSM 1987 – c W200.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Prepare site-specific Health and Safety Plan using City of Winnipeg template and submit within 7 days after date of Notice to Proceed and prior to commencement of Work. The template is available at the link: https://www.winnipeg.ca/matmgt/Safety/default.stm

.3 Health and Safety Plan must include:

.1 Results of site-specific safety hazard assessment.

.2 Results of safety and health risk or hazard analysis for site tasks and operation found in work plan.

.3 A hazard analysis specific to the project using the City of Winnipeg Safe Work Plan template shall be submitted by the Contractor prior to starting work.

.4 Fall Restraint requirements, certification

.5 WHMIS requirements, certification

.6 Wastewater hazard control

.7 Ventilation requirements

.8 Lead abatement

.9 Access/egress to the RAS Gallery

.10 Exterior/interior laydown area

.11 Manual isolation valve and pipe spool lift plans

.4 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.

.5 Submit copies of incident and accident reports.

.6 Submit WHMIS MSDS - Material Safety Data Sheets

.7 Contract Administrator will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 10 working days.

.8 Contract Administrator’s review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.

.9 Medical Surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of

Work, and submit additional certifications for any new site personnel to Contract Administrator.

.10 On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.

1.4 FILING OF NOTICE

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

.2 Contractor shall be responsible and assume the Principal Contractor role for each work zone location and not the entire complex. Contractor shall provide a written acknowledgement of this responsibility with 3 weeks of contract award.

.3 Work zone locations include:

.1 RAS Piping Gallery

.4 Contractor shall agree to install proper site separation and identification in order to maintain time and space at all times throughout life of project.

1.5 SAFETY ASSESSMENT

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

1.6 MEETINGS

.1 Schedule and administer Health and Safety meeting with Contract Administrator prior to commencement of Work.

1.7 REGULATORY REQUIREMENTS

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

1.8 PROJECT/SITE CONDITIONS

.1 Work at site will involve contact with:

.1 Lead Paint

.2 Potential contact with sewage

1.9 GENERAL REQUIREMENTS

.1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.

.2 Contract Administrator may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

1.10 RESPONSIBILITY

.1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.

.2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.11 COMPLIANCE REQUIREMENTS

.1 Comply with The Workers Compensation Act, Workplace Safety Regulation, Manitoba Reg. C.C.S.M. c. W210

.2 Comply with Occupational Health and Safety Regulations, 1996.

.3 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

1.12 UNFORSEEN HAZARDS

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

.2 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, advise Health and Safety co-ordinator and follow procedures in accordance with Acts and Regulations of Province having jurisdiction and advise Contract Administrator verbally and in writing.

1.13 HEALTH AND SAFETY CO-ORDINATOR

.1 Employ and assign to Work, competent and authorized representative as Health and Safety Co-ordinator. Health and Safety Co-ordinator must:

.1 Have site-related working experience specific to activities associated with municipal water pollution control centres.

.2 Have working knowledge of occupational safety and health regulations.

.3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.

.4 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.

.5 Be on site during execution of Work and report directly to and be under direction of the site supervisor.

1.14 POSTING OF DOCUMENTS

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

1.15 CORRECTION OF NON-COMPLIANCE

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

.2 Provide Contract Administrator with written report of action taken to correct non-compliance of health and safety issues identified.

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

1.16 POWDER ACTUATED DEVICES

.1 Use powder actuated devices only after receipt of written permission from Contract Administrator.

1.17 HOT WORK PERMITS

.1 Hot work permits shall be obtained on daily basis from the Contract Administrator for any hot work taking place during the day.

1.18 WORK STOPPAGE

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

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

Part 1 General

1.1 SCOPE OF WORK

.1 Provisions for temporary utilities as specified herein.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 INSTALLATION AND REMOVAL

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

.2 Remove from site all such work after use.

1.4 TEMPORARY HEATING AND VENTILATION

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

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

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

.1 Facilitate progress of Work.

.2 Protect Work and products against dampness and cold.

.3 Prevent moisture condensation on surfaces.

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

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

.4 Maintain temperatures of minimum 15 degrees 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 atmosphere of occupied areas.

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

.4 Ventilate storage spaces containing hazardous or volatile materials.

.5 Ventilate temporary sanitary facilities.

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

.6 Permanent heating system of building, to be used when available. Be responsible for damage to heating system if use is permitted.

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

.1 Conform with applicable codes and standards.

.2 Enforce safe practices.

.3 Prevent abuse of services.

.4 Prevent damage to finishes.

.5 Vent direct-fired combustion units to outside.

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

1.5 TEMPORARY POWER AND LIGHT

.1 The Contractor shall have access to convenience receptacles where available for construction power.

.2 Where additional construction power is required, space for a 600VAC feed, not to exceed 50 kVA from MCC-2A in the Secondary Clarifier Electrical Room will be made available. The Contractor shall be responsible for supplying and installing all breakers, cables, transformers, and panels necessary to bring temporary construction power to the desired location.

.3 The Contractor shall provide temporary lighting in areas where existing lighting is obstructed by scaffolding and other construction equipment. Existing lighting levels shall be maintained to permit continuation of City operations activities.

.4 The Contractor shall be responsible for providing temporary lighting for construction.

1.6 TEMPORARY COMMUNICATION FACILITIES

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

1.7 FIRE PROTECTION

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

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

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 SCOPE OF WORK

.1 Provide construction facilities as detained herein.

1.2 REFERENCE STANDARDS

.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.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 INSTALLATION AND REMOVAL

.1 Prepare site plan indicating proposed location and dimensions of area to be fenced and used by 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.

1.5 SCAFFOLDING

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

.2 Provide and maintain scaffolding, ramps, platforms, ladders, and temporary stairs.

1.6 HOISTING

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

.2 Hoists to be operated by qualified operator.

1.7 SITE STORAGE/LOADING

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

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

1.8 CONSTRUCTION PARKING

.1 Parking will be permitted on site provided it does not disrupt performance of the City's normal operations.

.2 Provide and maintain adequate access to project site.

1.9 SECURITY

.1 Construction site security, including laydown areas, is the responsibility of the contractor.

.2 The Contractor must receive approval from the City prior to hiring 24-hour security staff for their laydown area.

1.10 OFFICES

.1 Provide office heated to 22 degrees C, lighted 750 lx and ventilated, of sufficient size to accommodate site meetings and furnished with drawing laydown table.

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

.3 Subcontractors to provide their own offices as necessary. Direct location of these offices.

.4 Provide a space within the office for Contract Administrator use complete with a desk and chair.

1.11 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.

1.12 SANITARY FACILITIES

.1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances. Locate in area(s) designated by Contract Administrator.

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

.3 Contractor shall **not** use any the exiting sanitary facilities within the buildings.

1.13 CONSTRUCTION SIGNAGE

.1 No other signs or advertisements, other than warning signs, are permitted on site.

.2 Graphic symbols 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 Contract Administrator.

1.14 PROTECTION AND MAINTENANCE OF TRAFFIC

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

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

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

1.15 CLEAN-UP

.1 Work areas shall be cleaned **daily**. Incorporate effective dust control measures to keep the piping and pipe wrap in clean condition.

.2 Remove construction debris, waste materials, packaging material from work site **daily**.

.3 Clean dirt or mud tracked into facility immediately.

.4 Store materials resulting from demolition activities that are salvageable in designated areas.

.5 Stack stored new or salvaged material not in construction facilities.

.6 Snow clearing of the construction site and site access as and when required is the responsibility of the contractor.

1.16 SITE LAYDOWN AREA

.1 See Appendix G for details of the Contractor laydown area and access to the Secondary Clarifier Building and the RAS Gallery.

1.17 GANTRY CRANE & ACCESS HATCH

.1 Access to the maintenance shop located in the Secondary Clarifier Building shall only be provided during typical working hours for plant personnel (i.e. 08:00 to 16:00).

.2 A minimum of 5 business days notice is required prior to use of the gantry crane and blower room access hatch located in the maintenance shop to reduce disruption of plant maintenance work.

.3 Operation of the gantry crane shall be by the Contractor under direction and supervision of City staff. Responsibility for operation of the crane remains with the Contractor.

.1 The Contractor shall develop a simple lift plan prior to use and retain this plan for presentation upon request by the Contract Administrator. This plan shall include the proposed load and rigging arrangement, and results of a detailed inspection of the crane and rigging.

.2 The Contractor shall be responsible for damage to the crane, hatch or surrounding equipment resulting from use of the crane.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 PROJECT CLEANLINESS

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

.2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Contract Administrator. Do not burn waste materials on site.

.3 Clear snow and ice from access to building, bank/pile snow in designated areas only.

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

.5 Provide on-site containers for collection of waste materials and debris.

.6 Provide and use marked separate bins for recycling.

.7 Dispose of waste materials and debris off site.

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

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

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

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

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

1.2 FINAL CLEANING

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

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

.3 Prior to final review remove surplus products, tools, construction machinery and equipment.

.4 Remove waste products and debris.

.5 Remove waste materials from site at regularly scheduled times or dispose of as directed by Contract Administrator. Do not burn waste materials on site.

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

.7 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.

.8 Remove stains, spots, marks and dirt from decorative Work, electrical and mechanical fixtures, furniture fitments, walls, and floors.

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

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

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

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

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

.14 Remove dirt and other disfiguration from exterior surfaces.

.15 Clean and sweep roofs, gutters, areaways, and sunken wells.

.16 Sweep and wash clean paved areas.

.17 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.

.18 Clean roofs, downspouts, and drainage systems.

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

.20 Remove snow and ice from access to building.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

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

1.2 INTENT

.1 Minimize the amount of non-hazardous solid waste generated and maximize the reduction, reuse, and recycling of solid waste produced by this Work.

.2 Furnish all labour and equipment to collect, remove and dispose of all waste materials found on site prior to commencing Work and/or generated as a result of operations during any phase of construction.

.3 Respect environmental regulations and prevent environmental pollution damage.

1.3 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures

1.4 DEFINITIONS

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

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

.3 **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.

.4 **Reuse:** Repeated use of product in same form but not necessarily for same purpose. Reuse includes:

.5 **Salvaging**: reusable materials from re-modelling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.

.6 **Returning**: reusable items including pallets or unused products to vendors.

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

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

1.5 STORAGE, HANDLING AND PROTECTION

.1 Provide on-site facilities and containers for collection and storage of reusable and recyclable materials.

.2 Store, materials to be reused, recycled and salvaged in locations as directed by Waste Management Coordinator.

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

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

.5 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.

.6 Protect surface drainage, mechanical and electrical from damage and blockage.

.7 Separate and store materials produced during dismantling of structures in designated areas.

.8 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated facilities.

.9 Separate and store materials produced during project in designated areas.

.10 Remove co-mingled materials to off-site processing facility for separation.

.11 Provide waybills for separated materials removed from site.

.12 Materials reused on-site are considered to be diverted from landfill and as such are to be included in all reporting.

1.6 WASTE DISPOSAL

.1 Do not bury rubbish or waste materials.

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

.3 Keep records of construction waste including:

- .1 Number and size of bins.
- .2 Waste type of each bin.
- .3 Total tonnage generated.
- .4 Tonnage reused or recycled.
- .5 Reused or recycled waste destination.
- .6 Weigh bills from all waste and recycling destinations

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

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

.6 Consult with and obtain approval of Contract Administrator before removing waste materials.

.7 Dispose of materials unsuitable for reuse at option of Contractor, by means and at locations of choice. Upon approval of Contract Administrator, disposal areas may be located near building site.

.8 Trim stockpiles and waste to neat and presentable appearance.

.6 Take every precaution not to damage adjacent building finishes, or overhead or underground utilities. Retain liability for repair of damages occurring in performance of Work.

1.7 USE OF SITE AND FACILITIES

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

.2 Maintain security measures established by existing facility.

1.8 SCHEDULING

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

1.9 ENVIRONMENTAL REQUIREMENTS

.1 Where Work includes handling, hauling and disposing of environmentally sensitive (containment/pollutant), or hazardous materials, so such Work and locate waste or disposal areas to requirements, standards and approval of Manitoba Environment and Workplace Safety and Health, and all applicable regulations.

2 PRODUCTS

2.1 NOT USED

Not Used.

3 EXECUTION

3.1 APPLICATION

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

3.2 CLEANING

.1 Clean the Place of Work regularly. Leave areas clean at the end of each day.

.2 Perform final cleaning at project completion and remove surplus waste, materials, rubbish, tools, and equipment in accordance with Section 01 74 11 and as follows:

.3 Remove recycling containers and bins from site and dispose of materials at appropriate facilities.

.4 Separate materials to be reused/recycled into specific collection bins.

3.3 DIVERSION OF MATERIALS

.1 From following list below, separate waste materials into separate piles or containers as coordinated by the Waste Management Coordinator, and in compliance with applicable fire regulations.

.2 Clearly label containers or stockpiles for each type of material.

.3 Provide instruction on disposal practices.

.4 On-site sale of materials is not permitted unless approved by Contract Administrator.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE REQUIREMENTS

.1 Pre-warranty Meeting:

.1 Convene meeting one week prior to contract completion with Contract Administrator to:

.1 Verify Project requirements.

.2 Review warranty requirements.

.2 Contract Administrator shall establish communication procedures for:

.1 Notifying construction warranty defects.

.2 Determine priorities for type of defects.

.3 Determine reasonable response time.

.3 Contact information for bonded and licensed company for warranty work action: provide name, telephone number and address of company authorized for construction warranty work action.

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

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Two weeks prior to Substantial Performance of the Work, submit to the Contract Administrator, three final copies (hard copies and electronic PDF) of operating and maintenance manuals.

.3 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.

.4 Provide evidence, if requested, for type, source and quality of products supplied.

1.3 FORMAT

.1 Organize data as instructional manual.

.2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.

.3 When multiple binders are used correlate data into related consistent groupings.

.1 Identify contents of each binder on spine.

.4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.

.5 Arrange content by systems under Section numbers and sequence of Table of Contents.

.6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.

.7 Text: manufacturer's printed data, or typewritten data.

.8 Drawings: provide with reinforced punched binder tab.

.1 Bind in with text; fold larger drawings to size of text pages.

.9 Provide electronic PDF files in USB drives.

1.4 CONTENTS - PROJECT RECORD DOCUMENTS

.1 Table of Contents for Each Volume: provide title of project;

- .1 Date of submission; names.
- .2 Addresses, and telephone numbers of Contractor with name of responsible parties.
- .3 Schedule of products and systems, indexed to content of volume.

.2 For each product or system:

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

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

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

.5 Typewritten Text: as required to supplement product data.

- .1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00- Quality Control.

.6 Training: refer to Section 01 79 00- Demonstration and Training.

1.5 AS -BUILT DOCUMENTS AND SAMPLES

.1 Maintain at site for Contract Administrator one record copy of:

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

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

- .1 Provide files, racks, and secure storage.

.3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual.

- .1 Label each document "PROJECT RECORD" in neat, large, printed letters.

.4 Maintain record documents in clean, dry and legible condition.

- .1 Do not use record documents for construction purposes.

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

1.6 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

.1 Record information on set of drawings, and in copy of Project Manual, provided by Contract Administrator.

.2 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.

.3 Record information concurrently with construction progress.

.1 Do not conceal Work until required information is recorded.

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

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

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

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

.4 Field changes of dimension and detail.

.5 Changes made by change orders.

.6 Details not on original Contract Drawings.

.7 Referenced Standards to related shop drawings and modifications.

.5 Specifications: mark each item to record actual construction, including:

.1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.

.2 Changes made by Addenda and change orders.

.6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.

.7 Provide digital photos, if requested, for site records.

1.7 EQUIPMENT AND SYSTEMS

.1 For each item of equipment and each system include description of unit or system, and component parts.

.1 Give function, normal operation characteristics and limiting conditions.

.2 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

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

.3 Include installed colour coded wiring diagrams.

.4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences.

.1 Include regulation, control, stopping, shut-down, and emergency instructions.

.2 Include summer, winter, and any special operating instructions.

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

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

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

.8 Include sequence of operation by controls manufacturer.

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

.10 Provide installed control diagrams by controls manufacturer.

.11 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.

.12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

.13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

.14 Additional requirements: as specified in individual specification sections.

1.8 MAINTENANCE MATERIALS

.1 Spare Parts:

- .1 Provide spare parts, in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Deliver to location as directed; place and store.
- .4 Receive and catalogue items.
  - .1 Submit inventory listing to Contract Administrator.
  - .2 Include approved listings in Maintenance Manual.
- .5 Obtain receipt for delivered products and submit prior to final payment.

.2 Extra Stock Materials:

- .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Deliver to location as directed; place and store.
- .4 Receive and catalogue items.
  - .1 Submit inventory listing to Contract Administrator.
  - .2 Include approved listings in Maintenance Manual.
- .5 Obtain receipt for delivered products and submit prior to final payment.

.3 Special Tools:

- .1 Provide special tools, in quantities specified in individual specification section.
- .2 Provide items with tags identifying their associated function and equipment.
- .3 Deliver to location as directed; place and store.
- .4 Receive and catalogue items.
  - .1 Submit inventory listing to Contract Administrator.
  - .2 Include approved listings in Maintenance Manual.

1.9 DELIVERY, STORAGE AND HANDLING

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

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

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

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

.5 Remove and replace damaged products at own expense and for review by Contract Administrator.

1.10 WARRANTIES AND BONDS

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

.2 Submit warranty management plan, 30 days before planned pre-warranty conference, to Contract Administrator approval.

.3 Warranty management plan to include required actions and documents to assure that Contract Administrator receives warranties to which it is entitled.

.4 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.

.5 Assemble approved information in binder, submit upon acceptance of work and organize binder as follows:

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

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

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

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

.5 Co-execute submittals when required.

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

.6 Except for items put into use with City's permission, leave date of beginning of time of warranty until Date of Total Performance is determined.

.7 Conduct joint warranty inspection, measured from time of acceptance, by Contract Administrator.

.8 Include information contained in warranty management plan as follows:

.1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, subcontractors, manufacturers or suppliers involved.

.2 Provide list for each warranted equipment, item, feature of construction or system indicating:

.1 Name of item.

.2 Model and serial numbers.

.3 Location where installed.

.4 Name and phone numbers of manufacturers or suppliers.

.5 Names, addresses and telephone numbers of sources of spare parts.

.6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.

.7 Cross-reference to warranty certificates as applicable.

.8 Starting point and duration of warranty period.

.9 Summary of maintenance procedures required to continue warranty in force.

.10 Cross-Reference to specific pertinent Operation and Maintenance manuals.

.11 Organization, names and phone numbers of persons to call for warranty service.

.12 Typical response time and repair time expected for various warranted equipment.

.3 Contractor's plans for attendance at post-construction warranty inspections.

.4 Procedure and status of tagging of equipment covered by extended warranties.

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

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

.10 Written verification to follow oral instructions.

.1 Failure to respond will be cause for the Contract Administrator to proceed with action against Contractor.

1.11 WARRANTY TAGS

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

.2 Attach tags with copper wire and spray with waterproof silicone coating.

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

.4 Indicate following information on tag:

.1 Type of product/material.

.2 Model number.

.3 Serial number.

.4 Contract number.

.5 Warranty period.

.6 Inspector's signature.

.7 Construction Contractor.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 This Section contains requirements for training the City staff, by persons retained by the Contractor specifically for the purpose, in the proper operation and maintenance of the equipment and systems installed under this Contract.

.2 Training sessions are required during the equipment testing.

.3 As a minimum, the Contractor is to allow at least four (4) hours of training per shift, as required for each item of equipment or system, unless specified otherwise in the equipment Specifications.

.4 The intent is that the City should receive sufficient training on the equipment system that they are going to operate and maintain. The Contract Administrator shall have the authority to determine the duration and content of each training session required.

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Demonstrate operation and maintenance of equipment and systems to the City's personnel two weeks prior to date of substantial performance.

.2 Contract Administrator: provide list of personnel to receive instructions, and co-ordinate their attendance at agreed-upon times.

.3 Preparation:

- .1 Verify conditions for demonstration and instructions comply with requirements.
- .2 Verify designated personnel are present.
- .3 Ensure equipment has been inspected and put into operation.
- .4 Ensure testing, adjusting, and balancing has been performed and equipment and systems are fully operational.

.4 Demonstration and Instructions:

- .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at scheduled times, at the designated location.
- .2 Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.
- .3 Review contents of manual in detail to explain aspects of operation and maintenance.
- .4 Prepare and insert additional data in operations and maintenance manuals when needed during instructions.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit schedule of time and date for demonstration of each item of equipment and each system two weeks prior to designated dates, for Contract Administrator approval.

.3 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.

.4 Give time and date of each demonstration, with list of persons present.

.5 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

1.4 QUALITY ASSURANCE

.1 Where required by the equipment Specifications, provide on-the-job training of the City staff. Training sessions will be conducted by qualified factory-trained representatives of the various equipment suppliers with a minimum of two (2) years experience. Training includes instruction of City staff in equipment operation and preventive maintenance and instruction on mechanics, electricians, instrumentation, and communications technicians in normal maintenance up to major repair.

.2 The trainer(s) proposed by the Contractor shall be experienced in training plant operators and shall have relevant experience in similar work.

1.5 LOCATION

.1 Where specified, conduct training sessions for the City staff, operations and maintenance personnel, on the operation, care, and maintenance of the equipment and systems installed under this Contract. Training will take place at the Site of the Work and under the conditions specified in the following paragraphs.

.2 Field training sessions will take place at the site of the equipment. Classroom training to take place in the boardroom in the Administration Building. The Contract Administrator may direct the classroom training to take place at another suitable location.

1.6 LESSON PLANS

.1 Prepare formal written lesson plans for each training session and coordinate with the Contract Administrator. Lesson plans to contain an outline of the material to be presented along with a description of visual aids to be utilized during the session. Each plan will contain a time allocation for each subject. Furnish ten (10) copies of necessary training manuals, handouts, visual aids, and reference materials at least two (2) weeks prior to each training session.

1.7 FORMAT AND CONTENT

.1 Include time in the classroom and at the location of the equipment or system for each training session. As a minimum, cover the following topics for each item of equipment or system:

.1 Familiarization
.2 Safety
.3 Operation
.4 Troubleshooting
.5 Preventive maintenance
.6 Corrective maintenance
.7 Parts
.8 Local representatives

1.8 VIDEO RECORDING

.1 Advise all suppliers providing training sessions that the training sessions may be video-recorded. The material may be edited and supplemented with professionally produced graphics to provide a permanent record for the City's use.

1.9 TRAINING

.1 General Requirements

.1 Conduct training in conjunction with the equipment testing period. Schedule classes such that classroom sessions are interspersed with field instruction in logical sequence. Arrange to have the training conducted on consecutive days, with no more than four (4) hours of classes scheduled for any one (1) shift.

.2 Provide final operation and maintenance manuals, as defined in Section 017800, for the specific equipment to the City at least four (4) weeks prior to the start of any training. Video recording may take place concurrently with all training sessions.

.2 Operator Classroom Training

.1 As a minimum, classroom equipment training for operations personnel will include:

.1 The equipment's specific location in the plant and an operational overview. Use slides and drawings to aid discussion.

.2 Purpose and plant function of the equipment

.3 The operating theory of the equipment

.4 Start-up, shutdown, normal operation, and emergency operating procedures, including system integration and electrical interlocks.

.5 Safety items and procedures

.6 Routine preventive maintenance

.7 Operator detection, without test instruments, of specific equipment trouble symptoms

.8 Required equipment exercise procedures and intervals

.9 Routine disassembly and assembly of equipment if applicable for purposes such as operator inspection of equipment.

.3 Operator Hands-On Training

.1 As a minimum, hands-on equipment training for operations personnel will include:

.1 Identifying instrumentation: location of primary element; location of instrument readout; discuss purpose, basic operation, and information interpretation.

.2 Discussing, demonstrating, and performing standard operating procedures and daily visual inspection of system operation.

.3 Discussing and performing the preventive maintenance activities.

.4 Discussing and performing start-up and shutdown procedures.

.5 Performing the required equipment exercise procedures.

.6 Performing routine disassembly and assembly of equipment if applicable.

.7 Identifying and reviewing safety items and performing safety procedures, if feasible.

.4 Maintenance Classroom Training

.1 Classroom equipment training for the maintenance and repair personnel will include:

.1 Basic theory of operation.

.2 Description and function of equipment.

.3 Routine start-up and shutdown procedures.

.4 Normal and major repair procedures.

.5 Equipment inspection and troubleshooting procedures including the use of applicable test instruments and the "pass" and "no pass" test instrument readings.

.6 Routine and long-term calibration procedures.

.7 Safety procedures.

.8 Preventive maintenance and up to and including major repairs such as replacement of major equipment part(s) with the use of special tools.

.5 Maintenance Hands-On Training

.1 Hands-on equipment training for maintenance and repair personnel will include:

.1 Locating and identifying equipment components.

.2 Reviewing the equipment function and theory of operation.

.3 Reviewing normal repair procedures.

.4 Performing routine start-up and shutdown procedures.

.5 Reviewing and performing the safety procedures.

.6 Performing City-approved practice maintenance and repair job(s), including mechanical and electrical adjustments and calibration and troubleshooting equipment problems.

.7 Reviewing and using Contractor’s manuals in the hands-on training.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 23 05 93 “Testing, Adjusting, and Balancing for HVAC”

.2 Section 25 80 11 “Automation Commissioning”

.3 Section 25 90 01 “Sequence of Operations”

1.2 GENERAL

.1 Provide a fully functional facility and ensure that:

.1 Systems replaced or modified under this project shall meet or exceed the functionality and performance of the existing systems prior to replacement.

.2 City personnel have been fully trained in aspects of installed systems.

.3 Documentation relating to installed equipment and systems has been completed.

.2 Follow the requirements of this Specification section in conjunction with the Commissioning Plan report document in Appendix E, and Section 25 90 01 Sequence of Operations as they:

.1 Outline organization, scheduling, allocation of resources, and documentation pertaining to implementation of Cx.

.2 Communicate responsibilities of team members involved in Cx including scheduling, documentation requirements, and verification procedures.

.3 Set out deliverables relating to operation, maintenance, process, and administration of Cx.

.4 Describe process of verification of how built Works meet design requirements.

.5 Describe the intended operation of the chemical dosing systems.

.6 Set out scope, standards, roles and responsibilities, expectations, deliverables, and provides:

.1 An overview of Cx.

.2 A general description of elements that make up Cx Plan.

.3 A process and methodology for successful Cx.

.3 The NEWPCC wastewater treatment process will be in full operation throughout Cx and PV, and the Contractor shall take care to limit and avoid any disruption of the treatment process that is a critical service to the population of the City of Winnipeg.

1.3 ACRONYMS AND DEFINITIONS

.1 Bumping: short term start-up to prove ability to start and prove correct rotation.

.2 Cx - Commissioning.

.3 Commissioning Plan: The Cx planning document found in Appendix E.

.4 Cx Report: the final Cx document as described in Item 3.9.

.5 PI - Product Information.

.6 PV - Performance Verification.

.7 TAB - Testing, Adjusting, and Balancing.

1.4 SUBMITTALS

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

.2 Cx schedule to be revised, submitted, and accepted by the Contract Administer prior to the Pre-Commissioning Meeting.

.3 Cx Plan to be revised, submitted, and accepted by the Contract Administer prior to the Pre-Commissioning Meeting.

.4 Cx forms listed to be completed following the timing and procedure described by the document. The Contractor will abide by hold points, test witness points, and sign-offs described their-in. Any proposed deviations or changes to the forms shall be submitted by the Contractor prior to the Pre-Commissioning meeting for review by the Contract Administrator.

.1 Equipment Static Inspection Forms - Control Valve

.2 Equipment Static Inspection Forms - Pump

.3 Equipment Static Inspection Forms – Tank

.4 Equipment Static Inspection Forms – Sodium Hydroxide Piping

.5 Equipment Static Inspection Forms – Ferric Chloride Piping

.6 Equipment Start-Up Test Forms - Control Valve

.7 Equipment Start-Up Test Forms - Pump

.8 Equipment Start-Up Test Forms - Tank

.9 Functional Tests Forms - Compressed Air System

.10 Functional Tests Forms - New Ferric Chloride Chemical Delivery and Unloading – Rail

.11 Functional Tests Forms - New Ferric Chloride Chemical Storage

.12 Functional Tests Forms - New Ferric Chloride Chemical Dosing

.13 Functional Tests Forms - New Ferric Chloride Chemical Transfer

.14 Functional Tests Forms - New Sodium Hydroxide Chemical Delivery and Unloading

.15 Functional Tests Forms - New Sodium Hydroxide Chemical Storage

.16 Functional Tests Forms - New Sodium Hydroxide Chemical Dosing

.5 The following City of Winnipeg standard forms must be signed by the Contractor and OEM and submitted to the Contract Administrator at the stage of work specified in the form:

.1 CD-PM-TO-13: Form 100 – Certificate of Equipment Delivery

.2 CD-PM-TO-14: Form 101 – Certificate of Readiness to Install

.3 CD-PM-TO-15: Form 102 – Certificate of Satisfactory Installation

.4 CD-PM-TO-16: Form 103 – Certificate of Equipment Satisfactory Performance

.5 CD-PM-TO-17: Form 104 – Certificate of Satisfactory Process Performance

.6 Final Cx Report to be submitted electronically to the Contract Administrator within two weeks of completion of the Cx.

1.5 COMPOSITION, ROLES, AND RESPONSIBILITIES OF Cx TEAM

.1 Cx Team to consist of the following members:

.1 Contract Administrator who is responsible for:

.1 Monitoring Cx activities.

.2 Reviewing Contractor submissions.

.3 Assisting in the resolution of issues resulting from all tests.

.4 Reviewing the final Cx Report.

.2 City personnel who are responsible for

.1 Providing modifications to the existing Regional SCADA system to incorporate the new SCADAPack I/O.

.2 Supporting network communication between the new SCADAPack and the Regional SCADA network.

.3 Attending Cx activities to verify existing equipment operates as per the original sequence of operations including but not limited to:

.1 Existing Ferric Chloride Storage Tanks

.2 Existing Ferric Chloride Dosing Pumps

.3 Existing HVAC equipment

.4 Existing Hydronic system equipment

.5 Existing Domestic hot water equipment

.6 Existing Eyewash stations

.4 Attending Cx activities to verify newly installed equipment operates as intended including but not limited to:

.1 New Ferric Chloride Chemical Storage Tanks

.2 New Ferric Chloride Dosing Tanks

.3 New Sodium Hydroxide Chemical Storage Tanks

.4 New Air Compressor

.5 New Ferric Chloride Metering Pumps

.6 New Sodium Hydroxide Metering Pumps

.7 New Chemical Pot Feeders

.8 New HVAC equipment

.9 New Hydronic system equipment

.10 New Domestic hot water equipment

.11 New Eyewash stations

.3 Construction Team: Contractor, Subcontractors, suppliers, and support disciplines, whom are responsible for construction/installation in accordance with Contract Documents, including:

.1 Integrating commissioning activities into project schedule.

.2 TAB.

.3 Testing existing building equipment controls.

.4 Performing and documenting static verification.

.5 Performing and documenting start-up including installation/start-up checklists.

.4 The Contractor is responsible for implementing specified Cx activities including:

.1 Planning/preparing verification Cx forms and checklists.

.2 Determining operational training requirements.

.3 Leading construction Cx phase kickoff and Cx progress meetings.

.4 Performing and documenting PV effluent testing.

.5 Preparing and updating issues logs.

.6 Verifying, reviewing, and conducting training.

.7 Preparing final Cx report.

1.6 EXTENT OF Cx

.1 Building Mechanical Equipment

.1 New HVAC, hydronic system, and domestic hot water equipment shall be verified against the applicable flow, temperature, and pressure values listed in the equipment list LST-M-001, and on the drawings in the following areas.

.1 New Railcar Shelter 2 101B

.2 New Ferric Chloride Chemical Storage Room 101C

.3 New Sodium Hydroxide Chemical Storage Building 102

.2 Emergency Shower and Eyewash Stations

.1 New emergency shower and eyewash stations listed shall be tested to prove flow requirements noted in ANSI/ISEA Z358.1-2014 are met.

.1 New Station 4 (101B) EW-F5120 flow, time (Shower: 1.26 L/s, 15min.)

.2 New Station 5 (101B) EW-F5121 flow, time (Shower 1.26 L/s, 15min.)

.3 New Station 6 (101C) EW-F5220 flow, time (Shower 1.26 L/s, 15min.)

.4 New Station 7 (101C) EW-F5221 flow, time (Shower 1.26 L/s, 15min.)

.5 New Station 8 (102) EW-F5320 flow, time (Shower 1.26 L/s, 15min.)

.6 New Station 9 (102) EW-F5321 flow, time (Shower 1.26 L/s, 15min.)

.2 During each flow test, verify that the applicable emergency shower and eyewash station flow switch is activated, and that the plant SCADA system is notified.

.3 Electrical Equipment

.1 Process Controls

.1 Analog/Discrete I/O checks

.2 HVAC Controls

.3 Panel Boards

.4 Fire Alarm

.5 Card Access System

.1 Door switches

.2 Motion sensors

.3 Request to Exit

.4 Card Reader

.5 Electric Strike

.6 Surveillance System

.1 Railcar Shelter 1

.2 Railcar Shelter 2

.3 Electrical Room

.4 Building Exterior (Typical of three)

.7 Exit Lighting System

.8 Emergency Lighting System

.4 Process Systems: Compressed Air System

.1 Commission the new compressor unit by verifying the discharged compressed air pressure, flow, and dew point. Temporarily de-activate the existing units, partially

discharge air from the receivers (5-10 psi) and allow the new compressor to recharge. Verify output flow rate by measuring time required to fill the receivers to full pressure.

.1 New compressor CMP-F5010 pressure, flow – 72 ACFM, 175 psig, ##°C (pressure dew point)

.2 The following sensors in the new compressed air system shall be checked against the values provided during the ferric chloride unloading operation discussed in 1.6.8.

.1 Pressure sensor PIT-F8711 pressure reading – 70 kPa

.2 Pressure indicator PI-F8713 pressure reading – 70 kPa

.3 The following alarms, switches and interlocks shall be also tested during the ferric chloride unloading operation discussed in 1.6.8.

.1 Pressure alarm F8712-PSH on/off operation – 75 kPa

.5 Process Systems: New Ferric Chloride Chemical Delivery and Unloading - Rail

.1 Commission the chemical unloading system with water at 10-20 °C transferred from a portable tank located in the New Railcar Shelter 2 101B to each of the following locations.

.1 TK-F0710 – Existing Ferric Chloride Chemical Storage Tank 1

.2 TK-F0720 – Existing Ferric Chloride Chemical Storage Tank 2

.3 TK-F0730 – New Ferric Chloride Chemical Storage Tank 1

.4 TK-F0740 – New Ferric Chloride Chemical Storage Tank 2

.2 The water supply shall be stored in a suitable container that can be pressurized to 100 kPa to simulate the chemical unloading process using compressed air at 70 kPa.

.3 The valve line-up settings to unload from New Railcar Shelter 2 101B to each tank shall be checked for all of the valves listed.

.1 Flow control valve XV-F8700 open/closed/remote operation

.2 Flow control valve XV-F8701 open/closed/remote operation

.3 Flow control valve XV-F8702 open/closed/remote operation

.4 Flow control valve XV-F8703 open/closed/remote operation

.5 Flow control valve XV-F8704 open/closed/remote operation

.6 Flow control valve XV-F8705 open/closed/remote operation

.7 Flow control valve XV-F8717 open/closed/remote operation

.4 The flow rate through each flow meter listed shall be checked against water volume transferred over time.

.1 Flow element FE-F87021 flow check – 5.4 L/min

.2 Flow element FE-F87031 flow check – 5.4 L/min

.5 Each tank is to be filled completely to verify valve line ups, instrumentation, controls, and alarms, and then drained to the local sump.

.6 During testing, the following alarms, switches, and interlocks shall be tested.

.1 Ultrasonic level transmitter high-level alarm shall stop the unloading of ferric chloride and operate the three-way XV-F8701 or XV-W695 valve to vent compressed air from the Railcar.

.2 Hydrostatic transmitter high-level alarm shall stop the unloading of ferric chloride and operate the three-way XV-F8701 or XV-W695 to vent compressed air from the Railcar.

.3 Ultrasonic level transmitter Low-level alarm shall shutdown the dosing pumps.

.4 Hydrostatic transmitter low-level alarm shall shutdown the dosing pumps.

.5 Verify activation of emergency shutdown button HS-F87021, HS-F87022, HS-F87023, HS-F87024 and HS-F87025 shall stop the unloading of ferric chloride and operate the three-way valve XV-F8701 or XV-W695 to vent compressed air from the Railcar.

.6 Emergency stop railcar unloading alarm shall be communicated to SCADA.

.7 Verify flow meter FIT-F87021 and FIT-F87031 flow rate are communicated to SCADA.

.8 Verify flow meter FIT-F87021 and FIT-F87031 flow rate readings are consistent with the reading of local flow rate indication display FI-F87021 and FI-F87031 on panel LCP-F87001, LCP-F87002, LCP-F87004.

.6 Process Systems: New Ferric Chloride Chemical Storage

.1 Commission the chemical storage tanks by filling with water at 10-20 °C. Transfer water to storage tanks with the chemical transfer system and a portable tank as described in 1.6.8.

.2 Tank level readings from each device listed below shall be checked at 0%, 25%, 50%, 100% full levels against known water volumes added to the system.

.1 New Tank 3 TK-F0730 liquid level sensor LIT-F07301, level reading.

.2 New Tank 3 TK-F0730 liquid level sensor LT-F07302, level reading.

.3 New Tank 4 TK-F0740 liquid level sensor LIT-F07401, level reading.

.4 New Tank 4 TK-F0740 liquid level sensor LT-F07402, level reading.

.5 New Tank TK-G0750 liquid level sensor LIT-G07502, level reading

.6 New Tank TK-Y0790 liquid level sensor LIT-Y07902, level reading.

.3 Each tank is to be filled completely to verify valve line ups, sensors, and alarms, and then drained to the local sump, at which time the sump level switch shall be checked.

.4 During testing, the following alarms, switches, and interlocks shall be tested.

.1 Ultrasonic Level transmitter LIT-F07301 and hydrostatic level transmitter LT-F07302 at high level alarm (100%) shall stop unloading of ferric chloride and shall operate XV-F8701 or XV-W695 to vent compressed air from the Railcar.

.2 Ultrasonic level transmitter LIT-F07301 and hydrostatic level transmitter LT-F0302 at low level alarm (0%) shall stop the dosing pumps.

.3 Ultrasonic Level transmitter LIT-F07401 and Hydrostatic level Transmitter (LT-F07402) at high level alarm (100%) shall stop unloading of ferric chloride and shall operate XV-F8701 or XV-W695 to vent compressed air from the Railcar.

.4 Ultrasonic Level transmitter LIT-F07401 and Hydrostatic level Transmitter (LT-F07402) at low level alarm (0%) shall stop the dosing pumps.

.5 Verify Ultrasonic Level Indicating Transmitter LIT-F07301 reading is communicated to SCADA.

.6 Verify hydrostatic level transmitter LT-F07302 reading is communicated to SCADA and reading is consistent with ultrasonic level indicating transmitter LIT-F07301.

.7 Verify ultrasonic level indicating transmitter LIT-F07301 reading is consistent with the following local level indication display LI-F07301-1 to LI-F07301-4 on LCP-F87001 to LCP-F87004, respectively.

.8 Verify ultrasonic level indicating transmitter LIT-F07401 reading is communicated to SCADA.

.9 Verify hydrostatic level transmitter LT-F07402 reading is communicated to SCADA and reading is consistent with ultrasonic level Indicating transmitter LIT-F07401.

.10 Verify Ultrasonic Level Indicating Transmitter LIT-F07401 reading is consistent with the following local level indication display LI-F07401-1 to LI-F07401-4 on LCP-F87001 to LCP-F87004, respectively.

.11 Ultrasonic Level transmitter (LIT-G07502) at high level alarm (100%) shall stop the transfer pump P-F0781 or P-F0780, close inlet valves XV-G87095 and XV-G87090 of Tank TK-F0750.

.12 Verify transfer pumps P-F0781 or P-F0780 automatically turned on and associated inlet motorized valves XV-G87095 and XV-G87090 automatically opened when dosing tanks TK-F0750 low level sensor alarm triggered.

.13 Verify ultrasonic level indicating transmitter LIT-G07502 reading is consistent with the reading of local level indication LI-G07502-1 on panel LCP-F87003.

.14 Ultrasonic level transmitter LIT-G07502) reading and fault alarm are communicated to SCADA.

.15 Verify ultrasonic level indicating transmitter LIT-G07502 reading is consistent with the local level indication display LI-G07502-1 on panel LCP-F87003.

.16 Ultrasonic level transmitter (LIT-Y07902) at high level alarm (100%) shall stop the transfer pump P-F0781 or P-F0780, close inlet valves XV-Y87155 and XV-Y87150 of Tank TK-Y0790.

.17 Verify transfer pumps P-F0781 or P-F0780 automatically turned on and associated inlet motorized valves XV-Y87150 and XV-Y87155 automatically opened when dosing tanks TK-F0790 low level sensor alarm triggered.

.18 Verify Ultrasonic Level Indicating Transmitter LIT-Y07902 reading is consistent with the local level indication display LI-Y07902-1 on panel LCP-F87003.

.7 Process Systems: New Ferric Chloride Chemical Dosing

.1 Commission the chemical dosing system with water at 10-20 °C from the new chemical storage tanks to each of the following wastewater process locations:

.1 Existing centrifuge centrate dosing point 1.3

.2 New WEWPCC and SEWPCC trucked sludge dosing point 1.4

.3 New effluent from grit removal dosing point 2.1

.4 New primary effluent after the HPO reactors dosing point 4.1

.5 New primary effluent after the HPO reactors dosing point 4.2

.6 New primary effluent after the HPO reactors dosing point 4.3

.2 The valve line-up settings to dose from the storage tanks to each dosing point shall be checked for all of the valves listed below.

.1 Flow control valve XV-F8706 open/closed/remote operation

.2 Flow control valve XV-F8707 open/closed/remote operation

.3 The dosing pump settings and flow rates for each pump listed shall be checked.

.1 New Ferric Chloride Metering Pump P-F0770 – 400 L/min, 60 psi

.2 New Ferric Chloride Metering Pump P-F0771 – 400 L/min, 60 psi

.3 New Ferric Chloride Metering Pump P-F0772 – 400 L/min, 60 psi

.4 New Ferric Chloride Metering Pump P-G0751 – 200 L/min, 60 psi

.5 New Ferric Chloride Metering Pump P-Y0791 – 30 L/min, 60 psi

.6 New Ferric Chloride Metering Pump P-Y0792 – 30 L/min, 60 psi

.7 New Ferric Chloride Metering Pump P-Y0793 – 30 L/min, 60 psi

.4 The flow rate through each flow meter listed shall be checked against water volume transferred over time.

.1 Flow element F07703-FE flow check – 400 L/min

.2 Flow element F07713-FE flow check - 400 L/min

.3 Flow element F07723-FE flow check - 400 L/min

.5 During testing, the following alarms, switches, and interlocks shall be tested.

.1 High pressure alarm switch PSH-F07701 shall shutdown Metering Pump P-F0770.

.2 Verify high pressure alarm PSH-F07701.PAH is communicated to SCADA

.3 High pressure alarm switch PSH-F07711 shall shutdown Metering Pump P-F0771.

.4 Verify high pressure alarm PSH-F07711.PAH is communicated to SCADA

.5 High pressure alarm switch PSH-F07721 shall shutdown Metering Pump P-F0772.

.6 Verify high pressure alarm PSH-F07721.PAH is communicated to SCADA

.7 Verify flow meter indicating transmitter FIT-F07703 flow rate reading is communicated to SCADA.

.8 Verify flow meter indicating transmitter FIT-F07713 flow rate reading is communicated to SCADA

.9 Verify flow meter indicating transmitter FIT-F07723 flow rate reading is communicated to SCADA.

.8 Process Systems – New Ferric Chloride Chemical Transfer

.1 Commission the new chemical transfer system with water at 10-20 °C from the new chemical storage tanks TK-F0730/40 to each of the following locations:

.1 TK-G0750 – New Ferric Chloride Chemical Storage Tank

.2 TK-Y0790 – New Ferric Chloride Chemical Storage Tank

.2 The flow rate through each flow meter listed shall be checked against water volume transferred over time.

.1 Flow element F07804-FE flow check - 1500 L/min

.2 Flow element F07814-FE flow check - 1500 L/min

.3 The valve line-up settings to transfer from the new chemical storage tanks to the new remote chemical storage tanks shall be checked for the listed valves.

.1 Flow control valve XV-F8706 open/closed/remote operation

.2 Flow control valve XV-F8707 open/closed/remote operation

.3 Flow control valve XV-F8710 open/closed/remote operation

.4 Flow control valve XV-F8711 open/closed/remote operation

.5 Flow control valve XV-G87090 open/closed/remote operation

.6 Flow control valve XV-G87095 open/closed/remote operation

.7 Flow control valve XV-Y87150 open/closed/remote operation

.8 Flow control valve XV-Y87155 open/closed/remote operation

.4 The dosing pump settings and flow rates for each pump listed shall be checked.

.1 New Ferric Chloride Transfer Pump P-F0780 – 1500 L/min, 58 psi

.2 New Ferric Chloride Transfer Pump P-F0781 – 1500 L/min, 58 psi

.5 During testing, the following alarms, switches, and interlocks shall be tested.

.1 Refer to Section 1.6.6.4 for more information.

.2 Level switch high LSH-G07503 at high level alarm shall stop the transfer pump P-F0781 or P-F0780, close inlet valves XV-G87095 and XV-G87090 of Tank TK-G0750.

.3 Level switch high (LSH-Y07903) at high level alarm shall stop the transfer pump P-F0781 or P-F0780, close inlet valves XV-Y87150 and XV-Y87155 of Tank TK-Y0790.

.4 Verify low level alarms of all tanks are communicated to SCADA.

.5 Verify high level alarms of all tanks are communicated to SCADA.

.6 Verify ultrasonic level transmitter LIT-G07502 and LIT-Y07902 fault alarms are communicated to SCADA.

.7 Verify tank TK-G0750 leak alarm LS-G07904 and LS-G07905 are communicated to SCADA.

.8 Verify tank TK-Y0790 leak alarm LS-Y07904 and LS-Y07905 are communicated to SCADA.

.9 Verify sump pit level switch LSH-F8707 high level alarm is communicated to SCADA.

.9 New Sodium Hydroxide Chemical Delivery and Unloading

.1 Commission the new chemical unloading system with water at 10-20 °C transferred from a portable tank located outside the New Sodium Hydroxide Chemical Storage Building 102 to each of the following locations.

.1 TK-F0810 – New Sodium Hydroxide Chemical Storage Tank 1

.2 TK-F0820 – New Sodium Hydroxide Chemical Storage Tank 2

.2 The valve line-up settings to unload from the truck to the storage tanks in the shall be checked for the listed valves.

.1 Flow control valve XV-F8800 open/closed/remote operation

.2 Flow control valve XV-F8801 open/closed/remote operation

.3 Each tank is to be filled completely to verify valve line ups, instrumentation, controls, and alarms, and then drained to the local sump.

.4 During testing, the following alarms, switches, and interlocks shall be tested.

.1 Either Remote and panel mounted emergency shutdown button is pressed, the inlet valves XV-F8800 and XV-F8801 shall close and initiate an alarm and shutdown. Verify emergency shutdown alarm is communicated to SCADA.

.2 The control system detecting failure or non-responsiveness of a control valve initiates alarm and shutdown.

.3 Verify sump pit high level alarm LSH-W8803 is communicated to SCADA.

.4 Verify sump pit high level alarm LSH-W8804 is communicated to SCADA.

.10 New Sodium Hydroxide Chemical Storage

.1 Commission the new sodium hydroxide chemical storage tanks by filling with water at 10-20 °C. Transfer water to storage tanks with a portable tank and suitably sized pump.

.2 Tank level readings from each device listed below shall be checked at 0%, 25%, 50%, 100% full levels against known water volumes added to the system.

.1 New Tank 1 TK-F0810 liquid level sensor F08101-LE, level reading.

.2 New Tank 1 TK-F0810 liquid level sensor F08102-LT, level reading.

.3 New Tank 1 TK-F0810 liquid level sensor F08201-LE, level reading.

.4 New Tank 1 TK-F0810 liquid level sensor F08202-LT, level reading.

.3 Each tank is to be filled completely to verify valve line ups, sensors, and alarms, and then drained to the local sump, at which time the sump level switch shall be checked.

.4 During testing, the following alarms, switches, and interlocks shall be tested.

.1 Ultrasonic level transmitter LIT-W08101 high level alarm shall close the inlet valve XV-W8800 and shutdown and initiate an alarm. Verify high level alarm is communicated to SCADA.

.2 Hydrostatic level transmitter LT-W08102 high level alarm shall close the inlet valve XV-W8800 and shutdown and initiate an alarm. Verify high level alarm is communicated to SCADA.

.3 Ultrasonic level transmitter LIT-W08201 high level alarm shall close the inlet valve XV-W8801 and shutdown and initiate an alarm. Verify high level alarm is communicated to SCADA.

.4 Hydrostatic level transmitter LT-W08102 high level alarm shall close the inlet valve XV-W8801 and shutdown and initiate an alarm. Verify high level alarm is communicated to SCADA.

.5 Verify flow meter FIT-W08801 flow rate is communicated to SCADA.

.6 Verify ultrasonic level indicating transmitter LIT-W08101 reading is consistent with the local level indication display LI- W08101-1 on panel LCP-W87001.

.7 Verify ultrasonic level indicating Transmitter LIT-W08201 reading is consistent with the local level indication display LI- W08201-1 on panel LCP-W87001.

.8 Verify flow indicating transmitter FIT-W08801 reading is consistent with the local level indication display LI- W08201-1 on panel LCP-W87001.

.11 New Sodium Hydroxide Chemical Dosing

.1 Commission the new sodium hydroxide chemical dosing system with water at 10-20 °C from the new chemical storage tanks to each of the following wastewater process locations:

.1 New Primary sludge dosing point 1.5A/B

.2 New WEWPCC and SEWPCC trucked sludge dosing point 1.6

.2 The valve line-up settings to unload from the truck to the storage tanks in the New Sodium Hydroxide Chemical Storage Building 102 shall be checked for all of the valves listed below.

.1 Flow control valve XV-F8800 open/closed/remote operation

.2 Flow control valve XV-F8801 open/closed/remote operation

.3 The dosing pump settings and flow rates for each pump listed shall be checked.

.1 P-F0830 - Sodium Hydroxide Metering Pump – 400 L/min, 60 psi

.2 P-F0831 - Sodium Hydroxide Metering Pump – 400 L/min, 60 psi

.3 P-F0832 - Sodium Hydroxide Metering Pump – 400 L/min, 60 psi

.4 The flow rate through each flow meter listed shall be checked against water volume transferred over time.

.1 Flow element F08303-FE flow check – 400 L/min

.2 Flow element F08313-FE flow check – 400 L/min

.3 Flow element F08323-FE flow check – 400 L/min

.5 During testing, the following alarms and interlocks shall be tested.

.1 High pressure alarm switch PSH-F08301 shall shutdown Metering Pump P-F0830.

.2 Verify high pressure alarm PSH-F08301.PAH is communicated to SCADA

.3 High pressure alarm switch PSH-F08311 shall shutdown Metering Pump P-F0831.

.4 Verify high pressure alarm PSH-F08311.PAH is communicated to SCADA

.5 High pressure alarm switch PSH-F08321 shall shutdown Metering Pump P-F0832.

.6 Verify high pressure alarm PSH-F08321.PAH is communicated to SCADA

.7 Verify flow meter indicating transmitter FIT-F08303 flow rate reading is communicated to SCADA.

.8 Verify flow meter indicating transmitter FIT-F08313 flow rate reading is communicated to SCADA.

.9 Verify flow meter indicating transmitter FIT-F08323 flow rate reading is communicated to SCADA.

Part 2 Products

2.1 EQUIPMENT

.1 Provide sufficient instrumentation to verify and commission the installed systems.

Part 3 Execution

3.1 Cx SCHEDULE

.1 Revise the Cx schedule provided by the Contract Admistrator and submit for review and approval 7 days prior to the Pre-Commissioning meeting as noted in 1.4. Include:

.1 Milestones, testing, documentation, training, and Cx activities of components, equipment, subsystems, systems, and integrated systems.

.2 The majority of Cx activities must be completed before issuance of Substantial Performance.

.3 Seasonal commissioning of HVAC systems may be necessary during the warranty period.

.4 After approval, incorporate the Cx schedule into the construction schedule.

.5 Contractor, Contractor's Commissioning Agent, and Contract Administrator will monitor progress of Cx against the approved Cx schedule.

3.2 REFINEMENT OF Cx PLAN

.1 During the construction phase, revise, refine, and update the Cx Plan as required to include approved design and construction changes.

.2 At each revision, indicate revision number and date.

.3 Submit each revised Cx Plan to the Contract Administrator for review and acceptance.

3.3 PRE-Cx ACTIVITIES

.1 Conduct pre-start-up pressure, static, flushing, cleaning, and "bumping" testing 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 Cx specifications.

.2 Perform prestart up inspections prior to commencing Cx. Utilise approved installation/start-up check lists. Rectify any deficiencies to the Contract Administrator’s satisfaction.

.3 For HVAC and plumbing systems:

.1 Complete on-site visual inspections.

.2 "Bump" each item of equipment (MUAs, fans, and pumps) in its "stand- alone" mode.

.3 Complete pre-start-up checks and relevant documentation.

.4 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.

.4 All equipment static inspection and start-up checklists must be completed and signed by the Contractor and the Contract Administrator.

.5 The following City of Winnipeg forms must be signed and completed by the equipment supplier, Contractor, and Contract Adminstrator:

.1 CD-PM-TO-13: Form 100 – Certificate of Equipment Delivery

.2 CD-PM-TO-14: Form 101 – Certificate of Readiness to Install

.3 CD-PM-TO-15: Form 102 – Certificate of Satisfactory Installation

3.4 Cx METHODOLOGY

.1 The Contractor is responsible for providing the necessary tools, materials, and equipment for conducting the required tests.

.2 Any defects evident during commissioning shall be immediately corrected at the Contractor’s expense and the test repeated until operation is proven satisfactory.

.3 The Contractor shall submit completed testing and field commissioning record sheets provided by the Contract Administrator on which the results of the various checks and tests shall be recorded, dated, and approved by the OEM and/or installation Subcontractor and the Contract Administrator.

.4 The Contractor shall advise the Contract Administrator and the City in writing when the work may be inspected before proceeding with the next commissioning task. The equipment and systems shall not be started before the approval of the Contract Administrator has been obtained.

.5 Commissioning meetings will be conducted as applicable.

.6 The Contract Administrator to witness and certify reported results using the approved PI and Cx forms.

.7 The Contract Administrator reserves right to verify up to 30% of reported Cx results at random.

.1 Failure of randomly selected item shall result in rejection of applicable Cx form(s) and Final Cx Report.

.8 Upon completion of Cx to the satisfaction of the Contract Administrator, lock control devices in their final positions, indelibly mark settings, and include in the final Cx Report.

3.5 PROCESS VERIFICATION

.1 PV is to be performed in two six-week long periods under the direction/supervision of the process subconsultant. The two phases of PV are listed below and in the Cx schedule.

.1 Cx Phase 2 (PV): Summer 2023

.2 Cx Phase 3 (PV: Winter 2023/24

.2 For the duration of the two PV periods Effluent sampling and testing will be performed by the Contractor at the frequency specified by the process subconsultant. Testing must strictly adhere to the recommendations of the sampling device manufacturer and/or the testing agency. This includes sample storage temperature, delivery time, container type etc. The test results shall be provided to the Contract Administrator.

.3 Contractor to guarantee availability of trades necessary to support minor modifications needed during performance verification should any arise.

.4 Upon completion of Performance Verification, the Contractor shall submit:

.1 CD-PM-TO-16: Form 103 – Certificate of Equipment Satisfactory Performance

.2 CD-PM-TO-17: Form 104 – Certificate of Satisfactory Process Performance

3.6 FINAL Cx REPORT

.1 Contractor to submit the completed Cx Report within a maximum of two weeks of completion of the Cx. The final Cx report to be reviewed and accepted by the Contract Administrator prior to granting Substantial Performance.

.2 Final Cx Report to include:

.1 Startup, pre-Cx activities, and documentation for systems and equipment.

.2 Description of Cx activities and documentation.

.3 Description of Cx of integrated systems and documentation.

.4 Completed PI report forms.

.5 Completed installation checklists.

.6 Completed PV report forms.

.7 Pump performance curves (family of curves) with final point of actual performance.

.8 Completed testing and balancing report for AHUs, fans, hydronic systems, and heaters.

.9 Final settings of commissioned equipment.

.10 Training Plans.

.11 Prescribed activities to be undertaken by City personnel during the warranty period.

.3 Before the final Cx Report is accepted, individual reported results to be subject to verification by the Contract Administrator.

.4 If seasonal commissioning of HVAC systems is necessary during the warranty period, the Cx Report to be submitted without the HVAC systems Cx results. The Cx results for the HVAC systems to be submitted within one week of commissioning the HVAC systems for inclusion in the final Cx Report.

3.7 TRAINING PLAN AND O&M MANUAL

.1 Refer to Appendix E – Commissioning Plan, Section 3.0 Training.

.2 The Contractor is responsible for submitting the Operation and Maintenance (O&M) Manuals in accordance with the technical specifications and the Commissioning Plan report in Appendix E.

.3 Upon total completion of the project the final hand-over package shall be submitted by the Contractor to the Contract Administrator. It shall include all as-built drawings, installation records, and commissioning records.

.4 Standard Operating Procedures (SOPs) and Safe Work Plans (SWPs) will be provided for all new equipment and included in the O&M Manual.

.1 Any existing SOPs and SWPs affected by the project will be revised.

.5 Records of all signed commissioning and process verification forms and documents shall be kept by the contractor and included in the O&M manual submitted to the Contract Administrator at the end of the project.

END OF SECTION

PART 1 General

1.1 RELATED REQUIREMENTS

.1 03 20 00 Concrete Reinforcing

.2 03 30 00 Cast-In-Place Concrete

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA-A23.1-14/A23.2-19, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.2 CSA-O86-19 Engineering Design in Wood.

.3 CSA O121-17(R2022), Douglas Fir Plywood.

.4 CSA O151-17, Canadian Softwood Plywood.

.5 CSA O153-19, Poplar Plywood.

.6 CAN/CSA-O325-21, Construction Sheathing.

.7 CSA O437 Series-93(R2011), Standards for OSB and Waferboard.

.8 CSA S269.1-16 (R2021), Falsework and Formwork.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit shop drawings for formwork and falsework.

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

.3 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. Comply with CSA S269.1 for formwork and falsework drawings.

.4 Indicate formwork design data: permissible rate of concrete placement, and temperature of concrete, in forms.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Formwork materials:

.1 For concrete without special architectural features, use wood and wood product formwork materials to CSA-O121, CAN/CSA-O86, CSA O437 Series, CSA-O153.

.2 Form ties:

.1 Containment pit walls: Coil type with force fit waterstop disc and setback plastic cone that leaves a 50 mm deep hole in the concrete surface for waterproofing grouting.

.2 Other structures: removable, tapered or snap-off type of fixed or adjustable length with setback plastic cone that leaves a 25 mm minimum deep hole in concrete surface for grouting.

.3 Form liner:

.1 Plywood: medium density overlay Canadian Softwood Plywood to CSA O151.

.4 Form release agent: shall not leave a residue, discolour or stain concrete surface. Form release agent shall be compatible with final coating or waterproofing agent if applicable.

.1 Acceptable products:

RICH-COTE by NCA/ Acrow-Richmond Ltd.,

Sealtight Duogard by W.R. Meadows of Canada Ltd.,

Eucoslip VOX by Euclid Admixtures Canada Inc.,

or approved equal in accordance with B8.

.5 Form stripping agent: colourless mineral oil, non-toxic, biodegradable, low VOC, free of kerosene, with viscosity between 70 and 110s Saybolt Universal at 40 degrees C, flashpoint minimum 150 degrees C, open cup.

.6 Falsework materials: to CSA-S269.1.

.7 Water Stopped Form Ties: For containment pit walls, furnish one of the following:

.1 Orient water stops perpendicular to tie and symmetrical about center of tie.

.2 Design ties to prevent rotation or disturbance of center portion of tie during removal of ends and to prevent water leaking along tie.

.3 Through bolt ties are not permitted for water-holding structures.

PART 3 EXECUTION

3.1 FABRICATION AND ERECTION

.1 Verify lines, levels and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.

.2 Fabricate and erect falsework in accordance with CSA S269.1.

.3 Fabricate and erect formwork in accordance with CAN/CSA-S269.1 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA-A23.1/A23.2.

.4 Align form joints and make watertight.

.1 Keep form joints to minimum.

.5 Locate horizontal form joints for exposed columns and walls at ceiling line unless shown otherwise.

.6 Use 25 mm chamfer strips on external corners and/or 25 mm fillets at interior corners, joints, unless specified otherwise.

.7 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.

.1 Continuous pre-formed flashing reglets to forms where built-in flashings occur at concrete surfaces.

.2 PVC waterstops continuous without displacing reinforcement and in accordance with manufacturer's instructions. Heat seal all joints, intersections and splices.

.3 Where final work will be exposed to view, set form ties in neat regular patterns.

.8 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections.

.1 Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.

.9 Clean formwork in accordance with CSA-A23.1/A23.2, before placing concrete.

3.2 REMOVAL AND RESHORING

.1 Leave formwork in place for following minimum periods of time after placing concrete.

.1 7 days for walls and sides of beams.

.2 7 days for columns.

.3 14 days for beam soffits, slabs, decks and other structural members, or 7 days when replaced immediately with adequate shoring to standard specified for falsework.

.4 Time periods for walls and beam side forms may be reduced to 3 days if acceptable curing and cold weather protection is provided.

.2 In cold weather, the minimum time interval may be governed by the requirement for protection of concrete as specified elsewhere in these specifications. Generally, the minimum time interval may be governed by the curing requirements of Section 03 30 00 Cast-In-Place Concrete.

.3 Remove formwork when concrete has reached 70% of its design strength or minimum period noted above, whichever comes later, and replace immediately with adequate reshoring.

.4 Provide necessary reshoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required.

.5 Space reshoring in each principal direction at not more than 3000 mm apart.

.6 Re-use formwork and falsework subject to requirements of CSA-A23.1/A23.2.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Concrete Institute (ACI)

.1 SP-66-04, ACI Detailing Manual 2004.

.1 ACI 315-99, Details and Detailing of Concrete Reinforcement.

.2 ACI 315R-04, Manual of Engineering and Placing Drawings for Reinforced Concrete Structures.

.2 ASTM International

.1 ASTM A143/A143M-07 (R2020), Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.

.2 ASTM A185/A185M-07, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.

.3 ASTM A775/A775M-19, Standard Specification for Epoxy-Coated Reinforcing Steel Bars.

.3 CSA International

.1 CSA-A23.1-09/A23.2-19 Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.

.2 CAN/CSA-A23.3--19, Design of Concrete Structures.

.3 CSA-G30.18-21, Carbon Steel Bars for Concrete Reinforcement.

.4 CSA-G40.20/G40.21-13(R2018), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.5 CAN/CSA-G164-18, Hot Dip Galvanizing of Irregularly Shaped Articles.

.6 CSA W186-21, Welding of Reinforcing Bars in Reinforced Concrete Construction.

.4 Reinforcing Steel Institute of Canada (RSIC)

.1 RSIC-2020, Reinforcing Steel Manual of Standard Practice.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Prepare reinforcement shop drawings in accordance with RSIC Manual of Standard Practice and ACI 315

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

.1 Indicate placing of reinforcement and:

.1 Bar bending details.

.2 Lists.

.3 Quantities of reinforcement.

.4 Sizes, spacings, locations of reinforcement and mechanical splices if approved by Contract Administrator, with identifying code marks to permit correct placement without reference to structural drawings.

.5 Indicate sizes, spacings and locations of chairs, spacers and hangers.

.2 Detail lap lengths and bar development lengths to CAN/CSA-A23.3, unless otherwise indicated.

1.3 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

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

.2 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

.1 Substitute different size bars only if permitted in writing by Contract Administrator.

.2 Reinforcing steel: billet steel, grade 400, deformed bars to CSA-G30.18, unless indicated otherwise.

.3 Reinforcing steel: weldable low alloy steel deformed bars to CSA-G30.18.

.4 Cold-drawn annealed steel wire ties: to ASTM A82/A82M.

.5 Chairs, bolsters, bar supports, spacers: to CSA-A23.1/A23.2.

.6 Mechanical splices: subject to approval of Contract Administrator.

2.2 FABRICATION

.1 Fabricate reinforcing steel in accordance with CSA-A23.1/A23.2 ACI 315 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.

.1 ACI 315R unless indicated otherwise.

.2 Obtain Contract Administrator's written approval for locations of reinforcement splices other than those shown on placing drawings.

.3 Upon approval of Contract Administrator, weld reinforcement in accordance with CSA W186.

2.3 SOURCE QUALITY CONTROL

.1 Upon request, provide Contract Administrator with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 4 weeks prior to beginning reinforcing work.

.2 Upon request inform Contract Administrator of proposed source of material to be supplied.

Part 3 Execution

3.1 FIELD BENDING

.1 Do not field bend or field weld reinforcement except where indicated or authorized by Contract Administrator.

.2 When field bending is authorized, bend without heat, applying slow and steady pressure.

.3 Replace bars, which develop cracks or splits.

3.2 PLACING REINFORCEMENT

.1 Place reinforcing steel as indicated on placing drawings and in accordance with CSA-A23.1/A23.2.

.2 Prior to placing concrete, obtain Contract Administrator's approval of reinforcing material and placement.

.3 Ensure cover to reinforcement is maintained during concrete pour.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 03 10 00 Concrete Forming and Accessories

.2 03 20 00 Concrete Reinforcing

1.2 REFERENCES

.1 Abbreviations and Acronyms:

.1 Portland Cement: hydraulic cement, blended hydraulic cement (XXb - b denotes blended) and Portland-limestone cement.

.1 Type GU, GUb and GUL - General use cement.

.2 Type MS and MSb - Moderate sulphate-resistant cement.

.3 Type MH, MHb and MHL - Moderate heat of hydration cement.

.4 Type HE, HEb and HEL - High early-strength cement.

.5 Type LH, LHb and LHL - Low heat of hydration cement.

.6 Type HS and HSb - High sulphate-resistant cement.

.2 Fly ash:

.1 Type F - with CaO content less than 15%.Type CI - with CaO content ranging from 15 to 20%.

.2 Type CH - with CaO greater than 20%.

.3 GGBFS - Ground, granulated blast-furnace slag.

.2 Reference Standards:

.1 ASTM International

.1 ASTM C260/C260M-10a(R2016), Standard Specification for Air-Entraining Admixtures for Concrete.

.2 ASTM C309-19, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

.3 ASTM C494/C494M-19, Standard Specification for Chemical Admixtures for Concrete.

.4 ASTM C1017/C1017M-13, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.

.5 ASTM D1752--18, Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.

.2 CSA International

.1 CSA A23.1/A23.2-19, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.2 CSA A283-19, Qualification Code for Concrete Testing Laboratories.

.3 CSA A3000-18, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Provide testing results for review by Contract Administrator and do not proceed without written approval when deviations from mix design or parameters are found.

.3 Concrete pours: provide accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken as described in PART 3 - FIELD QUALITY CONTROL.

.4 Concrete hauling time: provide for review by Contract Administrator deviations exceeding maximum allowable time of 120 minutes for concrete to be delivered to site of Work and discharged after batching.

1.4 SUBMITTALS

.1 Submit the mix design and sieve analysis of all aggregate to the Contract Administrator for review a minimum of 10 days prior to delivery of any concrete to site. The Contract Administrator's review of mix design is for general conformance only, and in no way mitigates the contractor's obligation to provide concrete suitable for placing in the locations shown and meeting all the specified requirements.

.2 Do not place any concrete until materials and mix design are reviewed by Contract Administrator.

1.5 QUALIFICATIONS

.1 Concrete work shall be done by an established firm having at least 5 years of proven satisfactory experience in this trade and employing skilled personnel.

1.6 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.

.2 Provide Contract Administrator, minimum 4 weeks prior to starting concrete work, with valid and recognized certificate from plant delivering concrete.

.1 Provide test data and certification by qualified independent inspection and testing laboratory that materials and mix designs used in concrete mixture will meet specified requirements.

.3 Minimum 4 weeks prior to starting concrete work, provide proposed quality control procedures for review by Contract Administrator on following items:

.1 Falsework erection.

.2 Hot weather concrete.

.3 Cold weather concrete.

.4 Curing.

.5 Finishes.

.4 Quality Control Plan: provide written report to Contract Administrator verifying compliance that concrete in place meets performance requirements of concrete as established in PART 2 - PRODUCTS.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements:

.1 Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.

.1 Do not modify maximum time limit without receipt of prior written agreement from Contract Administrator and concrete producer as described in CSA A23.1/A23.2.

.2 Deviations to be submitted for review by Contract Administrator.

.2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.

Part 2 Products

2.1 DESIGN CRITERIA

.1 Alternative 1 - Performance : to CSA A23.1/A23.2, and as described in MIXES of PART 2 - PRODUCTS.

2.2 PERFORMANCE CRITERIA

.1 Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established by Contract Administrator and provide verification of compliance as described in PART 1 - QUALITY ASSURANCE.

.2 Portland Cement: to CSA A3001, Type GU, Type HS

.3 Blended hydraulic cement: Type GUb, Type HSb to CSA A3001.

.4 Supplementary cementing materials: with minimum 20% Type F fly ash replacement N GGBFS, by mass of total cementitious materials to CSA A3001.

.5 Water: to CSA A23.1.

.6 Aggregates: to CSA A23.1/A23.2.

.7 Admixtures:

.1 Air entraining admixture: to ASTM C260.

.2 Chemical admixture: to ASTM C494 ASTM C1017. Contract Administrator to approve accelerating or set retarding admixtures during cold and hot weather placing.

.8 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents to CSA A23.1/A23.2.

.1 Compressive strength: 40 MPa at 28 days.

.2 Net shrinkage at 28 days: maximum 0 %.

.9 Curing compound: to CSA A23.1/A23.2

.10 Waterstops: ribbed extruded PVC type complete with molded corner and intersection pieces.

.1 Cast-in waterstops:

.1 Waterstops for construction joints to have a minimum width of 150 mm unless noted otherwise on the drawings. Acceptable products: Durajoint Type 5 or Greenstreak 644.

.2 100 mm wide waterstops to be Durajoint Type 3 or Greenstreak 643.

.11 Premoulded joint fillers:

.1 Bituminous impregnated fiber board: to ASTM D1751.

.12 Form tie sealer: non-shrink, non-staining to match adjacent concrete surfaces on exposed work.

.13 Isolation joint sealant: polyurethane sealant. Acceptable products: Sikaflex, Vulkem 45 or approved equivalent.

.14 Bonding adhesive: two component epoxy resin, compatible with potable water. Acceptable products: Sikadur Hi-Mod by Sika or approved equal.

.15 Use compatible additives, admixtures, curing compounds and sealers.

2.3 MIXES

.1 Ensure concrete supplier meets performance criteria as established below and provide verification of compliance as in Quality Control Plan.

.1 Provide concrete mix to meet following hard state requirements:

.1 Piles and Base Slabs:

.1 Durability and class of exposure: S-2

.2 Compressive strength at 28 day age: 30 MPa minimum.

.3 Compressive strength at 56 day age: 32 MPa minimum.

.4 Water/Cement Ratio (W/C): 0.45

.5 Aggregate size 20 mm maximum.

.6 Entrained Air: 4%-7%

.2

.3 Grade Beams and Foundation Walls:

.1 Durability and class of exposure: S-2

.2 Compressive strength at 28 day age: 30 MPa minimum.

.3 Compressive strength at 56 day age: 32 MPa minimum.

.4 Water/Cement Ratio (W/C): 0.45

.5 Aggregate size 20 mm maximum.

.6 Entrained Air: 4%-7%

.4 Structural Slabs:

.1 Durability and class of exposure: C-1

.2 Compressive strength at 28 day age: 35 MPa minimum.

.3 Water/Cement Ratio (W/C): 0.45

.4 Aggregate size 20 mm maximum.

.5 Entrained Air: 5%-8%

.5 Exterior Slabs (Non-structural):
- .1 Durability and class of exposure: C-2
- .2 Compressive strength at 28 day age: 32 MPa minimum.
- .3 Water/Cement Ratio (W/C): 0.45
- .4 Aggregate size 20 mm maximum.
- .5 Entrained Air: 5%-8%

.6 Masonry fill concrete:
- .1 Durability and class of exposure: N
- .2 Compressive strength at 28 day age: 25 MPa minimum.
- .3 Water/Cement Ratio (W/C): 0.45
- .4 Aggregate size 20 mm maximum.
- .5 Entrained Air: N/A

.7 Lean-mix concrete:
- .1 Durability and class of exposure: N
- .2 Compressive strength at 28 day age: 15 MPa minimum.
- .3 Water/Cement Ratio (W/C): 0.45
- .4 Aggregate size 20 mm maximum.

.2 Provide quality management plan to ensure verification of concrete quality to specified performance.

.3 Concrete supplier's certification: both batch plant and materials meet CSA A23.1 requirements.

.4 Mix proportions shall produce a mixture which will work readily into corners and angles of forms and around reinforcement. Mix proportions shall not permit segregation and shall not cause excessive water to collect on the surface.

.5 The addition of water to concrete on site shall not be permitted.

Part 3 Execution

3.1 PREPARATION

.1 Obtain Contract Administrator's written approval before placing concrete. Provide 48 hours minimum notice prior to placing of concrete.

.2 Place concrete reinforcing in accordance with Section 03 20 00 - Concrete Reinforcing.

.3 During concreting operations:

- .1 Development of cold joints not allowed.
- .2 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.

.4 Pumping of concrete is permitted only after approval of equipment and mix.

.5 Ensure reinforcement and inserts are not disturbed during concrete placement.

.6 Prior to placing of concrete obtain Contract Administrator's approval of proposed method for protection of concrete during placing and curing.

.7 Protect previous Work from staining.

.8 Clean and remove stains prior to application for concrete finishes.

.9 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.

.10 In locations where new concrete is dowelled to existing work:

.1 Prepare existing concrete surface to CSP 7 profile (scarify to 6-8mm amplitude). Use methods that do not damage the slab. These include milling machines and shotblasting methods.

.2 Ensure prepared concrete surface free of debris, dust, oil prior to application of bonding agent.

.3 Apply bonding agent to prepared concrete surface following manufacturer's instructions. Approved products:

- Sikadur-32 Hi-Mod by Sika Group
- Intralok by W.R. Meadows
- MasterEmaco A 660 by BASF
- Or Approved Equal in Accordance with B8

3.2 INSTALLATION/APPLICATION

.1 Do cast-in-place concrete work to CSA A23.1/A23.2.

.2 Compact concrete thoroughly and uniformly by means of tamping, hand tools, vibrators or finishing machines to secure a dense, homogenous structure, close bond with reinforcement and smooth-formed surfaces.

.3 Use internal vibrator wherever possible. External vibrators may be used where a satisfactory finish cannot be achieved with internal vibrators alone.

.4 Where required, vibration to be supplemented with hand spading adjacent to the forms.

.5 Maintain one spare, workable vibrator at all times while concrete is being placed.

.6 Place concrete continuously between pre-set construction and control joints.

.7 Honeycomb or embedded debris in concrete is not acceptable. Notify Contract Administrator upon discovery.

.8 Remove and replace defective concrete as directed by the Contract Administrator.

.9 Sleeves and inserts:

.1 Do not permit penetrations, sleeves, ducts, pipes or other openings to pass through slab, except where indicated or approved by Contract Administrator.

.2 Where approved by Contract Administrator, set sleeves and other inserts and openings as indicated or specified elsewhere.

.3 Sleeves and openings greater than 200 x 200 mm not indicated, must be reviewed by Contract Administrator.

.4 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain written approval of modifications from Contract Administrator before placing of concrete.

.5 Confirm locations and sizes of sleeves and openings shown on drawings.

.6 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.

.10 Anchor bolts:

.1 Set anchor bolts to templates in co-ordination with appropriate trade prior to placing concrete.

.2 Grout anchor bolts in preformed holes or holes drilled after concrete has set only after receipt of written approval from Contract Administrator.

.1 Formed holes: 100 mm minimum diameter.

.2 Drilled holes: to manufacturers' recommendations.

.3 Protect anchor bolt holes from water accumulations, snow and ice build-ups.

.4 Set bolts and fill holes with epoxy grout.

.11 Grout under base plates using procedures in accordance with manufacturer's recommendations which result in 100% contact over grouted area.

.12 Curing:

.1 Finish concrete to CSA A23.1/A23.2.

.2 Use procedures as reviewed by Contract Administrator or those noted in CSA A23.1/A23.2 to remove excess bleed water. Ensure surface is not damaged.

.13 Joint fillers:

.1 Furnish filler for each joint in single piece for depth and width required for joint unless otherwise authorized by the Contract Administrator.

.2 When more than one piece is required for joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.

.3 Locate and form isolation, construction and expansion joints as indicated.

.4 Install joint filler.

.5 Use 12 mm thick joint filler to separate slab-on-grade from vertical surfaces and extend joint filler from bottom of slab to within 12 mm of finished slab surface unless indicated otherwise.

.14 Waterstops:

.1 Install continuous waterstops at all construction and expansion joints in the structure to produce a watertight structure.

.2 Be responsible for determining the location of all construction joints not shown on drawings in accordance with accepted practice for the production of a watertight concrete structure. Produce layout drawings detailing the location of all proposed construction joints for review by the Contract Administrator. The Contract Administrator reserves the right to request the use of additional joints to more closely follow the design intent and/or to suit site conditions.

.3 Each piece of waterstop to be of maximum practicable length in order that the number of end joints will be held to a minimum.

.4 Joints at intersections and at ends of pieces to be injection molded. Joints to develop effective water tightness fully equal to that of continuous waterstop

material and shall permanently develop not less than 50% of the mechanical strength of the parent section and shall permanently retain its flexibility.

.5 Only straight butt welds will be permitted in the field. All other heat welds must be performed by the manufacturer at the plant.

.6 Handle waterstop carefully to ensure proper placing and freedom from nail punctures.

.7 At horizontal waterstops, place concrete by hand, to ensure that there are no trapped air pockets, proper embedment and no misalignment.

.8 At vertical joints, wire the waterstop properly into position and place concrete carefully to prevent misalignment.

.9 Do not distort or pierce waterstop such as to hamper performance and displace reinforcement when installing waterstops.

.15 Construction Joints:

.1 Locate construction joints not shown on the drawings to least impair the strength of the structure. Locations to be reviewed by the Contract Administrator prior to construction of formwork and placement of reinforcement. The interface between concrete pours is classified as a construction joint if fresh concrete cannot be incorporated integrally by vibration with that previously placed.

.2 Reinforcing steel to be continuous across joints.

.3 Before placing new concrete on hardened concrete, retighten forms, roughen the surface of hardened concrete, remove laitance and saturate the surface with water in advance of concreting.

.4 Apply a bonding agent to concrete surfaces for all construction joints except as noted in this Section.

.16 Finishing.

.1 Finish concrete in accordance with CAN/CSA-A23.1.

.2 Use procedures acceptable to Contract Administrator or those noted in CAN/CSA-A23.1 to remove excess bleed water. Ensure surface is not damaged.

.3 Provide written declaration that compounds used are compatible.

.4 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radius edges unless otherwise indicated.

.5 Immediately after the removal of forms, cut all ties back 25 mm from the concrete face. Fins and protrusions shall be rubbed down or ground off. Remove all honeycombed and other defective concrete down to sound concrete.

.6 Patch all honeycombed areas, defective areas, and tie holes. The area to be patched and an area at least 150 mm wide surrounding it to be dampened to prevent absorption of water from the patching mortar. Make a patching mixture of the same material and of approximately the same proportions as used for the concrete, except omit the coarse aggregate. Use a suitable epoxy bonding agent. The mortar to be thoroughly consolidated into place and struck-off so as to leave the patch slightly higher than the surrounding surface. To permit initial shrinkage, leave it undisturbed for at least one hour before being finally finished. The patched area to be kept damp for at least seven days.

.7 Unexposed exterior concrete surfaces are to have a plain, smooth form finish.

.8 Slab and floor surfaces to receive the finish specified below.

.1 Interior formed concrete surfaces.

.1 Refer to Section 099112 - Specialty Chemical-Resistant Paintingor surface preparation for specialty chemical resistant wall coating for secondary containment wall surfaces; application shall be performed only after watertightness testing has been accepted.

.2 Finish exposed surfaces (other than specified for specialty chemical resistant surfaces) to Smooth Rubbed Finish conforming to CAN/CSA-A23.1-19

.2 Exterior formed concrete surfaces.

.1 Surfaces to receive insulation shall be finished to Smooth-Formed Finish conforming to CAN/CSA-A23.1-19

.2 Other surfaces shall be finished to Rough-Formed Finish conforming to CAN/CSA- A23.1-19, Clause 24.3.5.

3.3 SURFACE TOLERANCE

.1 Concrete tolerance to CSA A23.1

3.4 FIELD QUALITY CONTROL

.1 Site tests: conduct tests as follows:

.1 Concrete pours.

.2 Slump.

.3 Air content.

.4 Compressive strength at 7and 28 days.

.5 Air and concrete temperature.

.2 Three (3) concrete test cylinders and one (1) slump test shall be taken for every 50 cubic meters placement or each day concrete is placed, whichever is greater.

.3 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory designated by Contract Administrator for review to CSA A23.1/A23.2.

.1 Ensure testing laboratory is certified to CSA A283.

.4 Contractor shall pay for cost of Inspection and Testing.

.5 Contractor will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.

.6 Non-Destructive Methods for Testing Concrete: to CSA A23.1/A23.2.

.7 Inspection or testing by Contract Administrator will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.

.8 The Contractor will pay for costs of tests as specified in Section 01 45 00 – Quality Control.

3.5 CURING

.1 Moist cure in accordance with CAN/CSA A23.1

.2 Moist curing is deemed to be achieved only if one of the following methods are adopted:

.1 Continuous light sprinkling or ponding of clean water such as to saturate every exposed area of concrete subjected to the curing method.

.2 Providing an absorptive cover to the whole concrete surface subjected to the curing method, such as burlap, and keeping the cover continuously wet. Wet shall be defined as the extraction of free water from the absorptive cover by the action of hand-squeezing any quantity of the cover.

.3 Sealing the whole surface of the concrete subjected to the curing method with a continuous waterproof barrier approved by the Contract Administrator.

.4 Covering the whole surface of the concrete subjected to the curing method with polyethylene sheet which is continuously sealed with waterproof tape at every joint and maintained in such condition that will ensure the air trapped between the concrete surface and the polyethylene sheet is continuously maintained at 100% humidity.

.5 Covering the whole surface with Hydradsorb perforated curing cover as supplied by Wallace Construction Specialties Ltd or equal authorized by Contract Administrator.

.3 Submit method of curing to the Contract Administrator for written authorization. Curing method shall state the concrete element to which it is applicable.

.4 Commence moist curing immediately following the final set and continue uninterrupted for the specified moist curing period.

.5 Moist cure normal Portland cement concrete or sulphate-resisting cement concrete for at least seven days.

.6 Moist cure concrete floor slabs, regardless of cement classification, for seven days.

.7 Cure concrete walls as follows:

.1 Continuously soak top of wall.

.2 Loosen forms as soon as possible without damaging concrete.

.3 Maintain continuous supply of water to top of wall to keep inside of forms wet.

.8 Do not use curing compounds except with written authorization by the Contract Administrator. Do not use curing compounds on surfaces which are to receive concrete hardener, floor toppings, or bonded floor coverings such as paint or tile.

3.6 COLD WEATHER REQUIREMENTS

.1 Job preparation:

.1 Preparation for cold weather, including special supplementary equipment, where necessary, shall be done before commencing concrete placing. Ensure that procedures and methods used during cold weather are reviewed and authorized by the Contract Administrator.

.2 Do the work to CAN/CSA-A23.1.

.3 Take cold weather precautions whenever the ambient temperature is, or is expected to be, at or below 10º C.

.4 The Contractor shall have protective measures in place, or adjacent to the work, and these measures shall be reviewed by the Contract Administrator before any concrete is mixed or ordered.

.5 Utilize heated mix water and/or aggregate to achieve concrete temperature between 15º C and 25º C at the time of depositing into the forms.

.6 Maintain concrete temperatures between 10º C and 20º C for a minimum of three (3) days for unloaded areas, and six (6) days for areas receiving partial load.

.7 If enclosures are utilized to maintain concrete temperature, provide suitable access and removable inspection plates so that the temperature of the concrete may be measured and recorded at any time. Locate inspection plates to provide representative areas including corners and more exposed elements, and have their location reviewed by the Contract Administrator.

.8 Where the work is enclosed and heaters are used to provide heat:

.1 Provide an access strip at least 1 m wide between the work and the nearest heater.

.2 Do not discharge heater outlets directly toward the work.

.3 Duct heater exhausts outside enclosure.

.4 Install minimum-maximum thermometers inside the enclosure at the locations reviewed by the Contract Administrator.

.5 Maintain the humidity within the enclosure at or above 40 %.

.9 Removal of forms, shores and protection to conform to Section 03 10 00 – Concrete Forming and Accessories.

.10 At the termination of the protection period, do not allow the concrete temperature to drop more than 10º C in the first 24 hours.

3.7 HOT WEATHER REQUIREMENTS

.1 Job Preparation:

.1 Prepare for hot weather, including protection and curing, where necessary, before commencing concrete placing. Ensure that procedures and methods used during hot weather are reviewed and authorized by the Contract Administrator.

.2 Do the work to CAN/CSA-A23.1.

.3 Take hot weather precautions when concrete temperature at any time exceeds 25º C.

.4 Make available and in working order and adjacent to the work area before any concrete is mixed or ordered the equipment necessary to execute the work under these conditions.

.5 Use ice, low heat cement and pre-cooling of the aggregates as necessary to control concrete temperatures. Do not place concrete whose temperature exceeds 30º C in the mixer.

.6 Concrete whose temperature in the mixer is between 25ºC and 30ºC shall contain a retarder, which reduces mixing water requirements and increases strength.

.7 Protect forms and equipment, including both mixing and placing equipment, from the rays of the sun and cool by wetting as necessary to maintain a temperature of not more than 5º C in excess of ambient temperature nor more than 35ºC.

.8 Prior to placing concrete wet down forms and reinforcement and the area surrounding the work.

.9 Keep mixing time to the minimum, consistent with the production of the quality of concrete specified and place mixed concrete immediately.

.10 Provide windbreaks, sunshades, plastic sheeting or other materials as required by CSA A23.1, Clause 7.4 when the evaporation is expected to exceed the limits shown.

.11 Commence continuous wet curing as soon as the concrete has hardened sufficiently to prevent surface damage.

3.8 DEFECTIVE CONCRETE

.1 Concrete not meeting the requirements of the Specifications and Drawings shall be considered defective concrete.

.2 Concrete not conforming to the lines, details, and grade specified herein or as shown on the Drawings shall be modified or replaced at the Contractor's expense. Finished lines, dimensions, and surfaces shall be correct and true within tolerances specified herein and in the Section 03100.

.3 Concrete not properly placed resulting in honeycombing and other defects shall be repaired or replaced at the Contractor's expense.

.4 To conform to the strength requirements, the average of all tests shall exceed the specified strength. When three (3) or more tests of the same class of concrete are available, the average of any three (3) consecutive tests shall be equal to, or greater than the specified strength, and no strength test shall fall more than 3.5 MPa below the specified strength. If any of the criteria of the above clause are not met, the Contract Administrator shall have the right to require one or more of the following:

.1 Changes in mix proportions for the remainder of the Work

.2 Cores drilled and tested from the areas in question as directed by the Contract Administrator and in accordance with CAN/CSA-A23.2. The test results shall be indicative of the strength of the in-place concrete.

.3 Load testing of the structural elements.

.4 The changes in the mix proportions, cores drilled and tested, and load testing shall be at the Contractor's expense.

.5 Concrete failing to meet the strength requirements of this Specification shall be strengthened or replaced at the Contractor's expense.

3.9 CRACK REPAIRS AND PATCHING

.1 Allow Contract Administrator to review concrete surfaces immediately upon removal of formwork.

.2 Remove all exposed metal form ties, nails and wires, break off fins, and remove all loose concrete.

.3 Thoroughly wet all form tie holes and patch with patching mortar followed by proper curing.

.4 Chip away honeycombed and other defective surfaces to a depth of not less than 40 mm with the edges perpendicular to the surface. The area to be patched and a space at least 150 mm wide entirely surrounding it shall be wetted to prevent absorption of water from the patching mortar. Apply bonding agent to Manufacturer's instructions and patch with patching mortar followed by proper curing.

.5 The patch shall be made of the same material and of the same proportions as used for the concrete except that the coarse aggregate shall be omitted, and cement added to match the colour of the surrounding concrete. The amount of mixing water shall be as little as is consistent with the requirements.

.6 Utilize the best possible care and construction techniques to minimize cracking of reinforced concrete construction.

.7 Repair all cracks in concrete walls, slabs, footings and other structural components.

.8 Cracks which do appear shall be routed out on each face and repaired with waterproof grout in accordance with manufacturer's recommendation, except those cracks which are in excess of 0.50 mm width or deemed by the Contract Administrator to be structurally detrimental or subject to movement shall be epoxy grouted.

.9 Obtain authorization from Contract Administrator of pressure grouting techniques and epoxy materials to be utilized prior to proceeding with the work.

.10 Depth of epoxy grouting shall be sufficient to restore structural integrity and/or watertightness, as required, but shall not be less than 100 mm.

.11 Cure crack repairs to manufacturer's instructions.

.12 Under certain conditions, the Contract Administrator may consider the use of specialized methods and materials to attain watertight structures if requested by the Contractor. The Contractor shall obtain authorization from the Contract Administrator for repair methods and procedures prior to proceeding with the work.

.13 The repaired structure shall be subjected to water testing until a successful water test is attained.

3.10 PROTECTION

.1 Protect all work, including soil below and adjacent to existing footings, against freezing, overheating, rapid drying, flooding and overloading.

.2 Provide weatherproof coverings, hoardings and heating equipment as required to permit continuous construction throughout any winter or inclement weather and to maintain working and curing conditions and to protect the existing facilities.

3.11 WATERTIGHTNESS TESTING

.1 The liquid retaining secondary containment in the Chemical Storage Building shall be watertight and all precautions shall be taken, especially joint treatment, to construct watertight structures.

.2 Notify the Contract Administrator at least two (2) working days before commencing the watertightness test.

.3 The watertightness test shall be performed prior to the application of the coating for the containment area.

.4 The structure, when filled to 300 mm above expected containment level, shall be reviewed over a forty-eight (48) hour period for leakage including monitoring of visible leaks and testing for leaks by measurement.

.5 Filling the structures in preparation of the watertightness test shall be performed only after the wall and floor concrete have attained 100 percent of the design strength. Fill the structure with clean water forty-eight (48) hours prior to the watertightness test to allow for full saturation of the concrete.

.6 All water used for testing and re-testing shall be supplied as described in Section 015100 Temporary Utilities.

.7 The Contractor shall measure leakage during next forty-eight (48) hour period. The measurements shall be witnessed by the Contract Administrator. With the water at maximum operating level for forty-eight (48) hours, there shall be no visible moisture or wetness on areas that will be seen or backfilled and the leakage measured over a period of twenty-four (24) hours shall not exceed 0.10 percent of the water volume in the test period.

.8 Locate and repair all leaks until all leakage is remedied and repeat the forty-eight (48) hour watertightness test following each repair operation, at no additional cost to the Contract Administrator.

.9 Disposal of the water for all tests shall be at the Contractor's expense.

3.12 CLEANING

.1 Waste Management and disposal:

.1 Divert unused concrete materials to landfill.

.2 Provide appropriate area on job site where concrete trucks can be safely washed.

.3 Do not dispose of unused admixtures and additive materials into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.

.4 Prevent admixtures and additive materials from entering drinking water supplies or streams.

.5 Using appropriate safety precautions, collect liquid or solidify liquid with inert, non-combustible material and remove for disposal.

.6 Dispose of waste in accordance with applicable local, Provincial and National regulations.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 04 05 00 - Common Work Results for Masonry

.2 04 05 13 - Masonry Mortar and Grout

.3 04 05 19 - Masonry Anchorage and Reinforcing

.4 04 05 23 - Masonry Accessories

.5 04 21 13 – Brick Masonry

.6 04 22 00 – Concrete Unit Masonry

1.2 REFERENCE STANDARDS

.1 CSA Group (CSA)

.1 CAN/CSA-A165 Series-14(R2019), CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).

.2 CAN/CSA-A179-14 (R2019), Mortar and Grout for Unit Masonry.

.3 CAN/CSA-A371-14 (R2019), Masonry Construction for Buildings.

.2 International Masonry Industry All-Weather Council (IMIAC)

.1 Recommended Practices and Guide Specification for Cold Weather Masonry Construction.

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 masonry and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.

.2 Submit shop drawings detailing temporary bracing required, designed to resist wind pressure and lateral forces during installation.

.4 Samples:

.1 Provide samples as follows:

.1 Two (2) of each type of masonry unit specified

.2 One (1) of each type of masonry accessory specified

.3 One (1) of each type of masonry reinforcement and tie proposed for use

.4 As required for testing purposes

.5 Certificates: submit manufacturer's product certificates certifying materials comply with specified requirements.

.6 Test and Evaluation Reports:

.1 Submit certified test reports in accordance with Section 01 33 00 – Submittal Procedures.

.2 Test reports to certify compliance of masonry units and mortar ingredients with specified performance characteristics and physical properties.

.3 Submit data for masonry units, in addition to requirements set out in referenced CSA and ASTM Standards, indicating initial rates of absorption.

.7 Installer Instructions: provide manufacturer's installation instructions, including storage, handling, safety and cleaning.

.8 Manufacturer's Reports: provide written reports prepared by manufacturer's on-site personnel to include:

.1 Verification of compliance of work with Contract.

.2 Site visit reports providing detailed review of installation of work, and installed work.

1.4 CLOSEOUT SUBMITTALS

.1 Submit manufacturer's instructions for care, cleaning and maintenance of prefaced masonry units for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 EXTRA MATERIALS

.1 Submit manufacturer's instructions in accordance with Section 01 78 00 - Closeout Submittals covering maintenance requirements and parts catalogue, with cuts and identifying numbers.

1.6 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

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

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

.4 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.

.5 Protect masonry and other Work from marking and other damage. Protect completed Work from mortar droppings. Use non-staining coverings.

.6 Provide temporary bracing of masonry Work during and after erection until permanent lateral support is in place.

.7 Replace defective or damaged materials with new.

1.7 COLD WEATHER REQUIREMENTS

.1 Supplement Clause 5.15 of CSA A371 with the following requirements:

.1 Maintain temperature of mortar between 5ºC and 50ºC until batch is used.

1.8 HOT WEATHER REQUIREMENTS

.1 Protect freshly laid masonry from drying too rapidly, by means of waterproof, non-staining coverings.

Part 2 Products

.1 Materials

.2 .1 Masonry materials are specified in other Sections of Division 4.

Part 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 in notes to Clause 5.3 of CSA A371 apply.

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 plaster, tile, 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 PARGING

.1 Use parging mortar specified in Section 04 05 13.

.2 Apply parging mortar where indicated in uniform coating not less than 10 mm thick.

3.8 SUPPORT OF LOADS

.1 Use concrete to Section 03 30 00, 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.

3.9 PROVISION FOR MOVEMENT

.1 Leave a minimum of 40 mm space or as indicated on the Drawings, between top of non-load bearing walls and partitions and structural elements. Do not use wedges.

.2 Build masonry to tie-in with stabilizers, with provision for vertical movement.

3.10 CONTROL JOINTS

.1 Construct continuous control joints as indicated on the Drawings.

3.11 EXPANSION JOINTS

.1 Build-in continuous expansion joints as indicated on the Drawings.

3.12 FIELD QUALITY CONTROL

.1 Inspection and testing will be carried out by a testing laboratory designated by the Contract Administrator.

.2 The Contract Administrator will pay costs for testing.

.3 Costs for additional testing required as a result of defective materials will be the responsibility of the Contractor.

3.13 CLEANING

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

.1 Leave Work area clean at end of each day.

3.14 PROTECTION

.1 Temporary Bracing:

.1 Provide temporary bracing of masonry work during and after erection until permanent lateral support is in place.

.2 Bracing approved by Contract Administrator.

.3 Brace masonry walls as necessary to resist wind pressure and lateral forces during construction.

.2 Moisture 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 completed and protected by flashing or other permanent construction.

.2 Cover completed and partially completed work not enclosed or sheltered with waterproof covering at end of each work day. Anchor securely in position.

.3 Air Temperature Protection: protect completed masonry as recommended in 1.9, SITE CONDITIONS.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 04 05 00 - Common Work Results for Masonry

.2 04 05 19 - Masonry Anchorage and Reinforcing

.3 04 05 23 - Masonry Accessories

.4 04 21 13 - Brick Masonry

.5 04 22 00 - Concrete Unit Masonry

1.2 WORK INCLUDED

.1 Provide all materials and labour to perform the mortar and grout Work for all masonry walls indicated on the Drawings.

1.3 REFERENCE STANDARDS

.1 CSA Group (CSA)

.1 CSA A23.1/A23.2-19, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.

.2 CAN/CSA-A179-14 (R2019), Mortar and Grout for Unit Masonry.

.3 CAN/CSA-A371-14 (R2019), Masonry Construction for Buildings.

.4 CAN/CSA-A3000-18, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

.2 International Masonry Industry All-Weather Council (IMIAC)

.1 Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

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

.2 Submit 2 copies of WHMIS SDS in accordance with Section 01 35 29.06 - Health and Safety Requirements. Indicate VOCs mortar, grout, parging, colour additives and admixtures. Expressed as grams per litre (g/L).

.3 Samples:

.1 Samples: submit unit samples in accordance with Section 04 05 00 - Common Work Results for Masonry.

.4 Manufacturers' Instructions: submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

.1 Test Reports: submit certified test reports including sand gradation tests in accordance with CAN/CSA-A179 showing compliance with specified performance characteristics and physical properties, and in accordance with Section 04 05 00 - Common Work Results for Masonry.

.2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.3 Mock-ups:

.1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control and requirements of Section 04 05 00 - Common Work Results for Masonry.

1.6 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

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

.2 Store and protect masonry mortar and grout packages from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

1.7 SITE CONDITIONS

.1 Ambient Conditions: maintain materials and surrounding air temperature to:

.1 Minimum 10 degrees C prior to, during, and 48 hours after completion of masonry work.

.2 Maximum 32 degrees C prior to, during, and 48 hours after completion of masonry work.

.2 Weather Requirements: CAN/CSA-A371, International Masonry Industry All-Weather Council (IMIAC) - Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.

Part 2 Products

2.1 MATERIALS

.1 Mortar and grout: conforming to CSA A179

.2 Aggregate: conforming to CSA A82.56

.3 Water: clean, potable, free of injurious amounts of acids, alkalis, and organic material

.4 Masonry cement: conforming to CSA-A3000

.5 Portland cement: conforming to CSA-A3000, normal Type GU

.6 Hydrated lime: conforming to CSA A82.43

.7 Use aggregate passing 1.18 mm sieve where 6 mm thick joints are indicated.

.8 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

2.5 PARGING

.1 Parging mortar: Type S to CSA A179

Part 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 Testing of mortar materials will be carried out by an inspection and testing firm designated by the Contract Administrator.

.2 The Contract Administrator will pay costs for tests.

.3 Costs for additional testing required as a result of defective materials will be the responsibility of the Contractor.

.4 Submit samples of all materials proposed for testing.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 04 05 00 - Common Work Results for Masonry

.2 04 05 13 - Masonry Mortar and Grouting

.3 04 05 23 - Masonry Accessories

.4 04 21 13 - Brick Masonry

.5 04 22 00 - Concrete Unit Masonry

1.2 WORK INCLUDED

.1 Supply all material and labour for the incorporation of the masonry reinforcement and connectors into the Work of this Contract.

1.3 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM)

- .1 ASTM A 36/A 36M-14, Standard Specification for Carbon Structural Steel.
- .2 ASTM A 167-15, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- .3 ASTM A 307-14, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
- .4 ASTM A 580/A 580M-16, Standard Specification for Stainless Steel Wire.
- .5 ASTM A 641/A 641M-(R2014), Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
- .6 ASTM A 666-15, Standard Specification for Annealed or Cold-Worked Austenitic Stainless-Steel Sheet, Strip, Plate, and Flat Bar.
- .7 ASTM A 1022 16B, Standard Specification for Deformed and Plain Stainless-Steel Wire and Welded Wire for Concrete Reinforcement.

.2 CSA Group (CSA)

- .1 CSA A23.1/A23.2-14 (R2015), Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
- .2 CAN/CSA-A179-14, Mortar and Grout for Unit Masonry.
- .3 CAN/CSA-A370-14, Connectors for Masonry.
- .4 CAN/CSA-A371-14, Masonry Construction for Buildings.
- .5 CSA G30.18-09 (R2014), Carbon Steel Bars for Concrete Reinforcement.
- .6 CSA S304-14(R2015), Design of Masonry Structures.
- .7 CSA W186-M1990(R2012), Welding of Reinforcing Bars in Reinforced Concrete Construction.

.3 Reinforcing Steel Institute of Canada (RSIC)

- .1 Reinforcing Steel Manual of Standard Practice, 2004.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

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

.2 Submit 2 copies of WHMIS SDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.

.3 Shop Drawings:

.1 Submit drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.

.3 Submit drawings detailing bar bending details, anchorage details, lists and placement drawings

.4 On placement drawings, indicate sizes, spacing, location and quantities of reinforcement and connectors.

.4 Manufacturers' Instructions: submit manufacturer's installation instructions.

1.5 SOURCE QUALITY CONTROL

.1 If requested by the Contract Administrator, 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.

1.6 SITE MEASUREMENTS

.1 Make site measurements necessary for proper fit of members.

1.7 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

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

.2 Store and protect anchorage and reinforcing materials from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

.1 Bar reinforcement: to CSA A371 and CAN/CSA-G30.18, Grade 400

.2 Wire reinforcement: to CSA A371 and CSA-G30.3, truss type

.3 Connectors: to CSA A370 and CSA S304.1

.4 Corrosion protection: to CSA S304.1, galvanized

.5 Masonry anchors: acceptable products by Hilti, Simpson Strong-Tie, and Ramset/Redhead

.6 Control joint filler: preformed rubber, neoprene, or polyvinyl chloride materials of size and shape indicated.

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.

Part 3 Execution

3.1 GENERAL

.1 Install masonry connectors and reinforcement in accordance with CSA A370, CSA A371, CAN/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 BONDING AND TYING

.1 Bond walls of two (2) or more wythes using metal connectors in accordance with National Building Code, CSA S304.1, CSA A371, and as indicated.

.2 Tie masonry veneer to backing in accordance with National Building Code, CSA S304.1, CSA A371, and as indicated.

.3 Block shear connector by FERO to be installed as shown on the Drawings.

3.3 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.

3.4 GROUTING

.1 Grout masonry in accordance with CSA S304 and as indicated.

3.5 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.

3.6 LATERAL SUPPORT AND ANCHORAGE

.1 Do lateral support and anchorage in accordance with CSA S304.1 and as indicated.

3.7 CONTROL JOINTS

.1 Terminate reinforcement 25 mm short of each side of control joints unless otherwise indicated.

.2 Install continuous control joint fillers in control joints.

3.8 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.

3.9 FIELD TOUCH-UP

.1 Touch up damaged and cut ends of epoxy coated or galvanized reinforcement steel and connectors with compatible finish to provide continuous coating.

3.10 CLEANING

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

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 04 05 00 Common Work Results for Masonry

.2 Section 04 05 13 Masonry Mortar & Grouting

.3 Section 04 05 19 Masonry Anchorage and Reinforcing

.4 Section 04 21 13 Brick Masonry

.5 Section 04 22 00 Concrete Unit Masonry

1.2 REFERENCE STANDARDS

.1 ASTM International

.1 ASTM D 2240-15, Standard Test Method for Rubber Property - Durometer Hardness.

.2 CSA Group (CSA)

.1 CAN/CSA-A371-14, Masonry Construction for Buildings.

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 masonry accessories and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.

.2 Indicate on drawings:

.1 Flashing, installation details, sizes, spacing, location and quantities of fasteners.

.4 Samples:

.1 Submit 2 samples of masonry accessories as follows:

.1 Materials: cured, and coloured samples, illustrating colour and colour range. Include:

.1 Movement joint filler.

.2 Lap adhesive.

.3 Mechanical fasteners.

.4 Reglets.

.5 Brick vents.

.2 Moisture control material samples, illustrating colour and colour range, size, and shape. Include:

.1 Weep hole vents.

.2 Mortar diverters.

.3 Grout screens.

.3 Flashing material samples, illustrating colour and colour range, size, shape, and profile. Include as specified:

.1 Sheet metal flashings.

.2 Composite flashings.

.3 Plastic and rubber flashings.

1.4 QUALITY ASSURANCE

.1 Test Reports: submit certified test reports including sand gradation tests in accordance with CAN/CSA-A179 showing compliance with specified performance characteristics and physical properties, and in accordance with Section 04 05 00 - Common Work Results for Masonry.

.2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.3 Manufacturer's Instructions: submit manufacturer's instructions as follows:

.1 Submit installation instructions for fillers, adhesives, reglets, brick vents, weeps, vents, diverters, screens, flashings.

1.5 SITE MEASUREMENTS

.1 Make site measurements necessary to ensure proper fit of members.

1.6 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

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

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

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

.1 Movement joint filler: purpose-made elastomer to ASTM D 2240 of size and shape indicated

.1 Use low VOC products

.2 Material type: expanded polyethylene

.2 Lap adhesive: recommended by masonry flashing manufacturer. Use low VOC products.

.3 Weep hole vents: purpose-made PVC.

.4 Mechanical fasteners: recommended by flashing manufacturer to suit project requirements.

2.2 MOISTURE CONTROL

.1 Weep Hole Vents: PVC

.2 Cell vents: polypropylene plastic, honeycomb design.

.1 Size: 9.5 mm x 63.5 mm x 85.7 mm

.3 Mortar diverters: shaped and sized to suit cavity spaces.

.4 Grout Screens: 6 mm square monofilament screen fabricated form high-strength, non-corrosive polypropylene polymers to isolate flow of grout in designated areas.

2.3 FLASHINGS

.1 Sheet metal: galvanized steel

.1 Thickness: as noted on drawings.

Part 3 Execution

3.1 EXAMINATION

3.2 INSTALLATION: MATERIALS

.1 Install continuous movement joint fillers in movement joints at locations indicated on drawings.

.2 Lap adhesive: apply adhesive to flashing lap joints.

.3 Mechanical fasteners: install fasteners to suit application and in accordance with manufacturer's written installation instructions.

.4 Reglets: install reglets at locations indicated on drawings.

3.3 INSTALLATION: MOISTURE CONTROL

.1 Install weep hole vents in vertical joints immediately over flashings, in exterior wythes of cavity wall and masonry veneer wall construction, at maximum horizontal spacing of 600 mm on centre.

.2 Mortar diverters: install purpose made diverters in cavities where indicated and as directed, size and shape to suit purpose and function.

.3 Grout screens: install purpose made screens in cavities where indicated and as directed, size and shape to suit purpose and function.

3.4 INSTALLATION: FLASHINGS

.1 Build in flashings in masonry in accordance with CAN/CSA-A371

.1 Install flashings under exterior masonry bearing on foundation walls, slabs, shelf angles, and steel angles over openings, and at base of cavity wall and where cavity interrupted by horizontal members or supports and as shown on drawings. Install flashings under weep hole courses and as indicated.

.2 In cavity walls and veneered walls, carry flashings from front edge of exterior masonry, under outer wythe, then up backing minimum 150 mm, and as follows:

.1 For masonry backing embed or bond flashing 25 mm in joint.

.2 For concrete backing, insert or bond flashing into reglets.

.3 For wood frame backing, staple flashing to walls behind water resistive paper, and lap joints.

.4 For gypsum board and glass fibre faced sheathing backing, bond to wall using manufacturer's recommended adhesive.

.3 Lap joints 150 mm and seal with adhesive.

.2 Form flashing (end dams) at lintels, sills and wall ends to prevent water from travelling horizontally past flashing ends.

.3 Install vertical flashing where outer veneer returns at window or door jambs, to prevent contact of veneer with inner wall.

3.5 CLEANING

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

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 04 05 00 - Common Work Results for Masonry

.2 04 05 13 - Masonry Mortar and Grouting

.3 04 05 19 - Masonry Anchorage and Reinforcing

.4 04 05 23 - Masonry Accessories

.5 04 22 00 - Concrete Unit Masonry

1.2 REFERENCE STANDARDS

.1 ASTM International

.1 ASTM C 73-10, Standard Specification for Calcium Silicate Brick (Sand-Lime Brick).

.2 ASTM C 216-13, Standard Specification for, Facing Brick (Solid Masonry Units Made of Clay or Shale).

.3 ASTM C 129 – Non-Load Bearing Masonry Units

.2 Brick Industry Association (BIA)

.1 Technical Note No. 20-2006, Cleaning Brick Work.

.3 CSA Group (CSA)

.1 CAN/CSA-A82-06(R2011), Fired Masonry Brick Made from Clay or Shale.

.2 CAN/CSA-A165 Series-04(R2009), CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).

.3 CAN/CSA-A371-04(R2009), Masonry Construction for Buildings.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data: submit Manufacturer's Product Data for each type of masonry unit, accessory and other manufactured Products.

.2 Compliance: submit certifications that each type of masonry unit complies with specified requirements.

.3 Colour selection: for initial selection submit:

.1 Unit masonry samples showing full extent of colours and textures available for each type of exposed masonry unit required.

.2 Coloured mortar samples showing full extent of colours available.

.4 Samples: for verification purposes submit:

.1 Unit masonry samples for each type of exposed masonry unit include full range of colour and texture to be expected in completed Work.

.2 For selection of brick, submit products of all Manufacturers that the Manufacturers or their agents consider to be their closest match. Re-submit until match meets approval of Architect.

.3 Coloured masonry mortar samples for each colour required showing the full range of colour which can be expected in the finished Work. Label samples to indicate type and amount of colorant used.

.4

1.4 QUALITY ASSURANCE

.1 Test Reports: submit certified test reports including sand gradation tests in accordance with CAN/CSA-A179 showing compliance with specified performance characteristics and physical properties, and in accordance with Section 04 05 00 - Common Work Results for Masonry.

.2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.3 Mock-ups:

.1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control and requirements of Section 04 05 00 - Common Work Results for Masonry.

.1 Construct mock-up panel of brick construction 1200 x 1800 mm.

1.5 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

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

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

.3 Replace defective or damaged materials with new.

1.6 PROJECT CONDITIONS

.1 Protection of Work: during erection, cover top of walls with waterproof sheeting at end of each day’s Work. Cover partially completed structures when Work is not in progress.

.1 Extend cover a minimum 600 mm down both sides and hold cover securely in place.

.2 Do not apply uniform floor or roof loading for at least twelve (12) hours after building masonry walls or columns.

.3 Staining: prevent grout, mortar or soil from staining the face of masonry to be left exposed or painted. Remove grout or mortar in contact with such masonry immediately.

.4 Do not apply concentrated loads for at least three (3) days after building masonry walls or columns.

.5 Protect base of walls from rain-splashed much and/or mortar splatter by means of coverings spread on ground and over wall surfaces.

.6 Protect sills, ledges, and projections from droppings or mortar.

.7 Cold Weather Protection:

.1 Do not lay masonry units that are wet or frozen.

.2 Remove any ice or snow formed on masonry bed by carefully applying heat until top surface is dry to the touch.

.3 Remove masonry damaged by freezing conditions.

.4 For clay masonry units with initial rates of absorption which require them to be wetted before laying, comply with the following:

.1 For units with surface temperature above 0°C, wet with water heated to above 21°C.

.2 For units with surface temperature below 0°C, wet with water heated to above 54°C.

.8 Perform the following construction procedures while masonry Work is progressing. Temperature ranges indicated below apply to air temperature existing at time of installation, except for grout:

.1 For grout: temperature ranges apply to anticipated minimum night temperatures. In heating mortar and grout materials, maintain mixing temperature selected within 5.5°C.

.2 5°C to 0°C.

.1 Mortar: heat mixing water to produce mortar temperature between 5°C and 49°C.

.2 Grout: follow normal masonry procedures.

.3 0°C to -4°C:

.1 Mortar: heat mixing water and sand to produce mortar temperatures between 5°C and 49°C. Maintain temperatures of mortar on boards above freezing.

.2 Grout: heat grout materials to 32°C to produce in-place grout temperature of 21°C at end of Work day.

.4 -4°C to -7°C:

.1 Mortar: heat mixing water and sand to produce mortar temperatures between 5°C and 49°C. Maintain temperatures of mortar on boards above freezing.

.2 Grout: heat grout materials to 32°C to produce in-place grout temperature of 21°C at end of Work day.

.3 Heat both side of walls under construction using salamanders or other heat sources.

.4 Use windbreaks or enclosures when wind is in excess of 24 km/h.

.5 -7°C and below:

.1 Mortar: heat mixing water and sand to produce mortar temperatures between 5°C and 49°C.

.2 Grout: heat grout materials to 32°C to produce in-place grout temperature of 21°C at end of Work day.

.3 Masonry units: heat masonry units so that they are above 7°C at time of laying.

.4 Provide enclosure and auxiliary heat to maintain an air temperature of at least 5°C for twenty-four (24) hours after laying units.

.5 Do not heat mixing water for mortar and grout to above 71°C.

.9 Protect completed masonry and masonry not being worked on in the following manner: (temperature ranges indicated apply to mean daily air temperatures except for grouted masonry; if for grouted masonry, temperature ranges apply to anticipated minimum night temperatures.)

.1 5°C to 0°C.

.1 Protect masonry from rain or snow for at least twenty-four (24) hours by covering with weather-resistant membrane.

.2 0°C to -4°C.

.1 Completely cover masonry with weather-resistant membrane for at least twenty-four (24) hours.

.3 -4°C to -7°C:

.1 Completely cover masonry with weather-resistant insulating blankets or similar protection for at least twenty-four (24) hours; forty-eight (48) hours for grouted masonry.

.4 -7°C and below:

.1 Except as otherwise indicated, maintain masonry temperature above 0°C for twenty-four (24) hours using enclosures and supplementary heat, electric blankets, infrared lamps or other methods proven to be satisfactory. For grouted masonry maintain heated enclosure to 5°C for forty-eight (48) hours.

Part 2 Products

2.1 MASONRY UNITS, GENERAL

.1 Obtain masonry units from one Manufacturer, of uniform texture and colour for each kind required, for each continuous area and visually related areas.

2.2 BRICK MADE FROM CLAY OR SHALE

.1 General: comply with referenced standards and other requirements indicated below applicable to each form of brick required.

.2 Size: provide brick manufactured to the following actual dimensions to match existing building:

.1 Metric Modular Face Brick, 90 x 57 x 190

.3 Provide special molded shapes where indicated and for application requiring brick of form, size and finish on exposed surfaces which cannot be produced from standard brick sizes by sawing.

.4 For sills, caps, and similar applications resulting in exposure of brick surfaces which otherwise would be concealed from view, provide uncored or unfogged units with all exposed surfaces finished.

.5 Facing Brick: STM C-216, and as follows:

.1 Grade SW, .32 texture and colour: match main building

Part 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 2.5 m 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 1219 mm above another at any time. Build no more than 1500 mm of wall measured vertically in any one day.

.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 MORTAR AND POINTING

.1 Make all joints uniform in thickness, straight, in line, and with mortar compressed to form concave joints.

3.3 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.

3.4 CONTROL JOINTS

.1 Provide continuous vertical control joints in veneer walls at locations indicated. Form control joints as detailed. Stop masonry reinforcing each side of joints.

3.5 MASONRY REINFORCING

.1 Veneer shall be continuously reinforced and tied together in bed joints with masonry reinforcing at 400 o.c.

.2 Place masonry 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.

3.6 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.

3.7 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.

3.8 CLEANING

.1 On completion, remove any excess mortar and smears that may remain, using wood paddles or scrapers.

.2 Point or replace defective mortar to match existing as required or directed.

.3 Scrub surfaces to be cleaned using non-acid cleaning solution of type which will not harm constructed masonry. Consult with masonry unit Manufacturer for acceptable Product. Clean trial test area and obtain the Contract Administrator's permission to proceed.

.4 Use large amounts of water and do cleaning in accordance with solution Manufacturer's instructions.

.5 Repeat cleaning operations as often as necessary until Work is satisfactory.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 04 05 00 - Common Work Results for Masonry

.2 04 05 13 - Masonry Mortar and Grouting

.3 04 05 19 - Masonry Anchorage and Reinforcing

.4 04 05 23 - Masonry Accessories

.5 04 21 13 – Brick Masonry

1.2 REFERENCE STANDARDS

.1 ASTM International

.1 ASTM E 336-11, Standard Test Method for Measurement of Airborne Sound Attenuation Between Rooms in Buildings.

.2 CSA Group (CSA)

.1 CAN/CSA-A165 Series-04(R2009), CSA Standards on Concrete Masonry Units consists: A165.1, A165.2, A165.3.

.2 CAN/CSA-A371-04(R2009), Masonry Construction for Buildings.

.3 CSA S304.1-04(R2010), Design of Masonry Structures.

.4 CSA A370-14(R2018), Connectors for Masonry

.3 National Research Council Canada (NRC)

.1 National Building Code of Canada 2010 (NBC).

.4 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S101-07(R2010), Standard Methods of Fire Endurance Tests of Building Construction and Materials.

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 concrete masonry units and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 QUALITY ASSURANCE

.1 Test Reports: submit certified test reports including sand gradation tests in accordance with CAN/CSA-A179 showing compliance with specified performance characteristics and physical properties, and in accordance with Section 04 05 00 - Common Work Results for Masonry.

.2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.3 Mock-ups:

.1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control and requirements of Section 04 05 00 - Common Work Results for Masonry supplemented as follows:

.1 Construct mock-up panel of concrete unit masonry construction 1200 x 1800 mm.

1.5 DELIVERY, STORAGE AND HANDLING

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

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

.1 Offload concrete unit masonry packages using equipment that will not damage the surfaces.

.2 Do not use brick tongs to move or handle masonry.

.3 Storage and Handling Requirements:

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

.2 Do not double stack cubes of concrete unit masonry.

.3 Protect all materials from damage due to weather conditions.

.4 Cover masonry units with non-staining waterproof membrane covering.

.5 Allow air circulation around units.

.6 Installation of wet or stained masonry units is prohibited.

.7 Keep concrete unit masonry in individual cardboard packaging provided by manufacturer until units are ready to be installed.

.8 Store and protect concrete unit masonry from nicks, scratches, and blemishes.

.9 Replace defective or damaged materials with new.

1.6 COLD WEATHER REQUIREMENTS

.1 Conform to weather protection requirements of Clause 5.15 in CSA A371.

1.7 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.

Part 2 Products

2.1 MATERIALS

.1 Concrete blocks: to CSA A165.1, normal weight and strength units, type H/15/A/M, modular size.

.2 Special shapes: provide Type H/15/A/M bull-nosed units for exposed corners. Provide purpose made shapes for lintels and bond beams. Provide additional special shapes as indicated or required.

2.2 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 where exposed to view, but may be used where concealed.

Part 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 Extend non-load bearing partitions to underside of floor or roof construction above and provide 40 mm deflection clearance. Install lateral support angles and insulation filler as detailed.

.6 Construct walls upward in a uniform manner, no one portion being raised more than 1200 mm above another at any time. Build no more than 1500 mm of wall measured vertically in any one day.

.7 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 25 MPa concrete for two (2) courses below bearing points of structural members and where indicated on Drawings.

.2 Install building paper and wire mesh reinforcing in the bed below the second block course from top.

3.6 CONTROL JOINTS

.1 Provide continuous vertical control joints in concrete block partitions and walls at locations indicated, or at a maximum 6000 mm on center.

.2 Form control joints as detailed. Stop horizontal masonry reinforcing 25 mm from each side of joints.

3.7 EXPANSION JOINTS

.1 Construct expansion joints where indicated, as detailed.

3.8 MASONRY REINFORCING

.1 Concrete block walls and partitions mortar beds shall be continuously reinforced and tied together with masonry reinforcing in every second block bed joint.

.2 Place masonry mortar bed 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 mortar bed reinforcement minimum of 150 mm at splices and cut and bend corners.

.5 Vertical and horizontal core reinforcement as indicated on Drawings. Lap reinforcement based on CSA A23.1 requirements.

.6 Vertical reinforcing bars to be continuous into lintels, through intermediate bond beams, and hooked into top of wall bond beams. Fill cores with 25 MPa concrete.

3.9 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 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 Contract Administrator's authorization.

3.10 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.

3.11 REINFORCED BLOCK LINTELS

.1 Install reinforced concrete block lintels over openings as indicated on the Drawings using 25 MPa concrete.

.2 Cast and cure lintels on plank. Set special channel lintel blocks using specified mortar.

.3 Place wood stops at either end of lintel to prevent movement.

.4 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.

.5 Minimum bearing shall be 400 mm each side of openings.

3.12 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.

3.13 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 which 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.

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

.7 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 09 91 23 – Interior Painting

.2 05 21 00 – Steel Joist Framing

.3 05 31 00 – Steel Decking

.4 05 50 00 – Metal Fabrication

1.2 WORK INCLUDED

.1 Structural steel framing for Building 101 (Ferric Chloride Chemical Storage Building) and Building 102 (Sodium Hydroxide Chemical Storage Building)

.2 Bearing plates and anchor bolts

.3 Welds, bolts, washers, nuts, and shims

.4 Prime interior structural steel members and appurtenances

.5 Field touch-up of primed and painted surfaces including field welding

1.3 DEFINITIONS

.1 Application Specialist: An individual who performs surface preparation and application of protective coatings and linings to steel and concrete surfaces of complex industrial structures.

1.4 REFERENCE STANDARDS

.1 Use the loads shown on Drawings and in accordance with the National Building Code of Canada.

.2 ASTM International (ASTM)

.1 ASTM A 36/A 36M-08, Standard Specification for Carbon Structural Steel.

.2 ASTM A 193/A 193M-08, Standard Specification for Alloy-Steel and Stainless-Steel Bolting Materials for High-Temperature or High-Pressure Service and Other Special Purpose Applications.

.3 ASTM A 307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.4 ASTM A 325-07a, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

.5 ASTM A 325M-08, Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength[Metric].

.6 ASTM A 490M-04ae, Standard Specification for High-Strength Steel Structural Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints Metric.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-85.10-99, Protective Coatings for Metals.

.4 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturers Association (CPMA).

.1 Handbook of the Canadian Institute of Steel Construction.

.2 CISC/CPMA Standard 2-75, Quick-Drying Primer for use on Structural Steel.

.5 CSA Group (CSA)

.1 CSA G40.20/G40.21-[04], General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

.3 CAN/CSA-S16-01(R2007), Limit States Design of Steel Structures.

.4 CAN/CSA-S136-07, North American Specifications for the Design of Cold Formed Steel Structural Members.

.5 CSA W47.1-03, Certification of Companies for Fusion Welding of Steel.

.6 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.

.7 CSA W55.3-1965(R2003), Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.

.8 CSA W59-03, Welded Steel Construction (Metal Arc Welding).

.6 Master Painters Institute

.1 MPI-INT 5.1-08, Structural Steel and Metal Fabrications.

.2 MPI-EXT 5.1-08, Structural Steel and Metal Fabrications.

.7 The Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE) International

.1 NACE No. 3/SSPC SP-6-06, Commercial Blast Cleaning.

.8 NACE International

.1 NACE International

.1 ANSI/NACE No. 13/SSPC-ACS-1-2016 -SG, Industrial Coating and Lining Application Specialist Qualification and Certification.

.9 Connections not shown on the Drawings are to be designed by a Professional Engineer registered in the Province of Manitoba, Canada. Design connections for loads shown or indicated on the Drawings.

1.5 INSPECTION AND TESTING

.1 Shop and field inspection and testing is to be performed by an Inspection and Testing Firm appointed and paid by the Contract Administrator.

.2 Provide free access to all portions of work in the shop and in the field and cooperate with appointed firm.

.3 Pay all additional costs for inspection and re-inspection due to defective workmanship or materials.

.4 If requested by the Contract Administrator, submit four (4) copies of mill test reports, properly correlated to materials actually used.

.5 Radiographic and magnetic particle inspection of welds is to be performed by the Inspection and Testing Firm, in accordance with CSA W59 and ASTM E109, when required by the Contract Administrator.

.6 Welds are to be considered defective if they fail to meet quality requirements of CSA W59.

.7 Additionally, all welds are to be visually inspected.

.8 High Tensile bolted connections are to be inspected and tested in accordance with CSA S16.1.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Provide a fabrication and erection schedule to the Contract Administrator prior to commencement of shop fabrication and field erection, in ample time to allow proper scheduling of inspection and testing.

.3 Submit details of typical connections and special connections for review prior to preparation of Shop Drawings.

.4 Responsibility for verification and correlation of field dimensions, fabrication processes, techniques of construction, installation, and coordination of all parts of the Work rests with the Contractor.

.5 Coordinate with steel joist supplier for any connections to joists.

.6 Indicate welded connections using welding symbols in compliance with CISC Welding Standards. Clearly indicate net weld lengths.

.7 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.

.2 Clearly indicate profiles, sizes, spacing, and locations of structural members, connections, attachments, reinforcing, anchorage, size and type of fasteners, cambers and loads, accessories, and setting details.

.3 Shop Drawing review by the Contract Administrator is solely to ascertain conformance to the general design concept.

.4 Responsibility for approval of detail design inherent in Shop Drawings rests with the Contractor and review by the Contract Administrator shall not imply such approval.

.5 Review shall not relieve the Contractor of his responsibility for errors or omissions in Shop Drawings or for proper completion of the Work in accordance with the Contract Documents.

.8 Erection drawings:

.1 Submit erection drawings indicating details and information necessary for assembly and erection purposes including:

.1 Description of methods.

.2 Sequence of erection.

.3 Type of equipment used in erection.

.4 Elevations.

.5 Temporary bracings.

.9 Fabrication drawings:

.1 Submit fabrication drawings showing designed assemblies, components and connections are stamped and signed by qualified professional engineer licensed in Manitoba, Canada.

.10 Fabricator Reports:

.1 Provide structural steel fabricator's affidavit stating that materials and products used in fabrication conform to applicable material and products standards specified and indicated.

.11 Certificates:

.1 Submit certifications for Application Specialists to demonstrate compliance to the requirements of ANSI/NACE No.13.

1.7 QUALIFICATIONS

.1 All work is to be performed by a firm certified by the Canadian Welding Bureau to the requirements of CSA W47.1 in Division 1 or Division 2.1.

.2 All welders employed for erection are to possess valid "S" Classification Class "O" certificates issued by the Canadian Welding Bureau.

.3 Maintain a current and valid ACS certification during project period.

.1 Application specialists who perform surface preparation and coating application work on this project must have a current ACS.

.4 Notify Contract Administrator of any change in application specialist certification status.

.1 Any delays to the completion of the Project due to invalid certifications will not be considered, and liquidated damages shall not be waived for any non-performance by Contractor.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials in manufacturer's original, undamaged containers with identification labels intact.

Part 2 Products

2.1 MATERIALS

.1 All materials shall be new

.2 Structural steel: conforming to CSA G40.21, Type W with minimum yield strength of 350 MPa

.3 Hollow structural sections: conforming to CSA G40.21, Type W, minimum yield strength of 350 MPa, Class C

.4 Bolts, nuts, and washers: conforming to ASTM A325; galvanized or painted to match fastened items

.5 Welding materials: conforming to CSA W59

.6 Interior structural steel primer: CISC/CPMA 2-75

2.2 FABRICATION

.1 Fabricate structural steel members in accordance with CSAS16.1 and CSA S136.

.2 Verify all drawing dimensions prior to commencing fabrication.

.3 Provide connections for design loads shown on the Drawings.

.4 Provide for field connections to be bolted except where field welded connections are shown on the Drawings. Bolted connections shall be bearing-type connections with the thread excluded from the planes of shear.

.5 All shop connections are to be welded.

.6 All exposed welds shall be of smooth neat appearance; grind or file if required.

.7 Design and detail connections for structural steel so that corrosion potential is minimized.

2.3 SHOP PAINTING

.1 Structural steel shall be finish-painted at the fabrication shop.

.2 Special Coating: primed steel columns and beams below main floor elevation (EL 100 000) and Railcar Shelter Unloading Platform to receive specialty chemical-resistant coating; see Section 09 91 12 for any surface preparation requirements.

.3 Clean all members remove loose mill scale, rust, oil, dirt, and other foreign matter. Prepare surfaces according to SSPC SP7.

.4 Apply paint in the shop to all steel surfaces, except:

.1 Surfaces to be encased in concrete

.2 Surfaces and edges to be field welded

.5 Apply paint under cover, on dry surfaces only and when surface and air temperatures are above 5°C.

.6 Maintain dry condition and 5°C minimum temperature until paint is thoroughly dry.

.7 Patch paint sharp edges and corners one coat before full coat is applied.

.8 Apply paint by brush or spray to specified dry film thickness.

Part 3 Execution

3.1 EXAMINATION

.1 Before starting erection, take field measurements and examine other work that may affect this work.

.2 Notify the Contract Administrator of any conditions, which would compromise proper installation of this work.

.3 Commencement of this work implies acceptance of existing conditions.

3.2 DAMAGED MEMBERS

.1 Repair or replace members damaged during transit or erection before securing in position.

3.3 ERECTION

.1 Erect structural steel in accordance with CSA S16.1 and Drawings.

.2 Field connections are to be bolted wherever possible.

.3 Do not field weld wet surfaces or during rain unless under cover.

.4 Do not weld at temperature below 5°C except with express permission of the Contract Administrator.

.5 Conform to requirements of CSA W59 for minimum preheat and interpass temperatures.

.6 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.

.7 Use only light drifting to draw parts together. Enlarge holes for bolted connections with reamers or twist drill only. Do not burn to form holes, enlarge holes, or match unfair holes.

.8 Erection error is not to exceed requirements of CSA S16.1.

.9 Obtain Contract Administrator's written permission prior to field cutting or altering structural members.

.10 After erection, field paint welds and touch-up abrasions and damaged surfaces. Bolt tightening to be done in accordance with Turn-of-Nut Tightening as per CSA S16.1.

3.4 CLEANING

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 09 91 23 – Interior Painting

1.2 WORK INCLUDED

.1 Joist design

.2 Standard type steel joists and bridging

.3 Bearing plates and angles with anchors

.4 Joist stools and anchor bolts for joists

.5 Plate clips for additional roof framing

.6 Welding to steel supports

.7 Shop prime paint steel joists and appurtenances

.8 Field touch-up of primed surfaces

1.3 DEFINITIONS

.1 Application Specialist: An individual who performs surface preparation and application of protective coatings and linings to steel and concrete surfaces of complex industrial structures.

1.4 REFERENCE STANDARDS

.1 Provincial Construction Safety Act

.2 Latest edition of the National Building Code of Canada.

.3 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturer's Association (CPMA)

.1 CISC/CPMA 2-75-1975, Quick-Drying, Primer for Use on Structural Steel.

.2 CISC/CPMA 1-73a-1975, Quick-Drying, One-Coat Paint for Use on Structural Steel.

.3 CISC “Code of Standard Practice for Buildings”

.4 CISC “Steel Joist Facts”

.4 CSA Group (CSA)

.1 CSA G40.20-13 /G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 CSA S16-14, Design of Steel Structures.

.3 CSA S136-12, North American Specification for the Design of Cold Formed Steel Structural Members.

.4 CSA W47.1-09(R2014), Certification of Companies for Fusion Welding of Steel.

.5 CSA W55.3-08(2013), Certificate of Companies for Resistance Welding of Steel and Aluminum.

.6 CSA W59-13, Welded Steel Construction (Metal Arc Welding) Metric.

.5 The Master Painters Institute (MPI)

.1 Architectural Painting Specification Manual - current edition.

.6 NACE International

.1 NACE International

.1 ANSI/NACE No. 13/SSPC-ACS-1-2016 -SG, Industrial Coating and Lining Application Specialist Qualification and Certification.

1.5 INSPECTION AND TESTING

.1 Shop and field inspection and testing is to be performed by an Inspection and Testing Firm appointed and paid by the Contract Administrator.

.2 Provide free access to all portions of Work in the shop and in the field and cooperate with appointed firm.

.3 Pay all additional costs for inspection and re-inspection due to defective workmanship or materials.

.4 If requested by the Contract Administrator, submit four (4) copies of mill test reports, properly correlated to materials actually used.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Provide a fabrication and erection schedule to the Contract Administrator prior to commencement of shop fabrication and field erection, in ample time to allow proper scheduling of inspection and testing.

.3 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for [steel joist framing] and include product characteristics, performance criteria, physical size, finish and limitations.

.4 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.

.2 Indicate particulars, on shop drawings, relative to joist geometry, framed openings, splicing details, bearing and anchorage, bridging spacing. Include member size, properties, specified and factored member loads, and stresses under various loadings, deflection and camber.

.3 Clearly indicate profiles of rolled sections, sizes, spacing, and location of joists, connections, bridging, reinforcing, anchorage, cambers, loads, and accessories.

.4 Include erection drawings, elevations, and details.

.5 Coordinate with the metal fabrication supplier for connections to joists for the catwalk hangers.

.6 Indicate welded connections using welding symbols in compliance with CISC Welding Standards. Clearly indicate net weld lengths.

.7 Shop Drawing review by the Contract Administrator is solely to ascertain conformance to the general design concept.

.8 Responsibility for approval of detail design inherent in Shop Drawings rests with the Contractor and review by the Contract Administrator shall not imply such approval.

.9 Review shall not relieve the Contractor of his responsibility for errors or omissions in Shop Drawings or for proper completion of the Work in accordance with the Contract Documents.

.5 Certificates:

.1 Submit certifications for Application Specialists to demonstrate compliance to the requirements of ANSI/NACE No.13.

.6 Responsibility for verification and correlation of field dimensions, fabrication processes, techniques of construction, installation, and coordination of all parts of the Work rests with the Contractor.

1.7 QUALITY ASSURANCE

.1 Qualifications:

.1 All Work is to be performed by a firm certified by the Canadian Welding Bureau to the requirements of CSA W47.1 Division 1 or 2.1.

1.8 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

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

.2 Replace defective or damaged materials with new.

1.9 SITE CONDITIONS

.1 Verify dimensions and condition of existing work; report discrepancies and potential problem areas to Contract Administrator for direction before commencing fabrication.

Part 2 Products

2.1 MATERIALS

.1 All materials are to be new.

.2 Steel: structural type conforming to CAN/CSA-G40.21, Type W 380 MPa for chord sections and 260 MPa minimum for web material, shop primed

.3 Anchor Bolts: fabricated from material conforming to CAN/CSA G40.21, Type W, yield strength 300 MPa; nuts and washers to be of equal or greater strength than bolts

.4 Welding Materials: conforming to CSA W59

.5 Primer: CISC/CPMA 2-75 for joists to be finish painted

2.2 FABRICATION

.1 Fabricate steel joists in accordance with CAN/CSA S16.1.

.2 Verify all Drawing dimensions prior to commencing fabrication.

.3 Fabricate joists of straight members arranged to form a triangulated truss type structure without joint eccentricities.

.4 No splices are allowed in chord members.

.5 Fabricate bottom joist chord extensions where indicated.

.6 Fabricate joist webs to permit passage of mechanical ducts as detailed. Reinforce joists in accordance with design conditions.

.7 Fabricate and weld plate clips to steel joist as indicated on the Drawings for additional channel roof framing. Coordinate with metal fabrication supplier for requirements.

.8 Camber joists for dead load deflection.

2.3 SHOP PAINTING

.1 Clean all members and remove loose mill scale, rust, oil, dirt, and other foreign matter. Prepare surface according to SSPC SP 7.

.2 Apply one (1) coat of prime paint in the shop to all steel surfaces, except:

.1 Surfaces to be encased in concrete

.2 Surfaces to receive field installed stud shear connectors

.3 Surfaces and edges to be field welded

.3 Apply primer paint under cover on dry surfaces only and when surface and air temperatures are above 5□C.

.4 Maintain dry condition and 5□C minimum temperature until paint is thoroughly dry.

.5 Patch paint bolts, nuts, sharp edges, and corners one coat before full prime coat is applied.

.6 Apply paint by brush or spray to a dry film thickness of 0.05 mm minimum.

Part 3 Execution

3.1 EXAMINATION

.1 Before starting erection, take field measurements and examine other Work which may affect this Work.

.2 Notify the Contract Administrator of any conditions which would prejudice proper installation of this Work.

.3 Commencement of this Work implies acceptance of existing conditions.

3.2 DAMAGED MEMBERS

.1 Repair or replace members damaged during transit or erection, before securing in position.

3.3 ERECTION

.1 Erect steel joists in accordance with CAN/CSA-S16.1 and Drawings.

.2 Provide minimum 100 mm bearing for joists supported on concrete and masonry. Provide minimum 65 mm bearing for joists supported on steel supports.

.3 Extend bearing chords to center of supports to reduce eccentricity.

.4 During erection provide all temporary bracing required for induced loads and stresses.

.5 Coordinate placement of anchor bolts and bearing plates in masonry construction.

.6 Field weld joists to bearing plates and steel supports after alignment and positioning.

.7 Provide bridging and bracing.

.8 Do not weld at temperature below 5ºC except with written permission of the Contract Administrator.

.9 Do not field weld wet surfaces or during rain unless under cover.

.10 Conform to CSA W59 for minimum preheat and interpass temperatures.

.11 Do not permit erection of decking until joists are sufficiently braced and bridging is installed.

.12 Obtain Contract Administrator's written permission prior to field cutting or altering joists or bridging.

.13 After erection, field prime anchorages, bearing plates, field welds, and other appurtenances, abrasions, and damage to shop primer.

3.4 CLEANING

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

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by steel joist framing installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 07 92 00 - Joint Sealants

.2 09 91 23 - Interior Painting

1.2 WORK INCLUDED

.1 Metal roof deck complete with cover plates, closures, flashing, fastenings, and installation

.2 Angles complete with required anchorage

.3 Angle framing around openings up to 450 mm maximum in any dimension

.4 Cut openings through deck

1.3 DEFINITIONS

.1 Application Specialist: An individual who performs surface preparation and application of protective coatings and linings to steel and concrete surfaces of complex industrial structures.

1.4 REFERENCE STANDARDS

.1 ASTM International (ASTM)

.1 ASTM A 653/A 653M-15e1, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 ASTM A 780-01 Standard Practice for Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings.

.3 ASTM A 792/A 792M-10 (2015), Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

.2 Canadian Sheet Steel Building Institute (CSSBI)

.1 CSSBI 10M-[13], Standard for Steel Roof Deck.

.2 CSSBI 12M-[15], Standard for Composite Steel Deck.

.3 CSA Group (CSA)

.1 CSA C22.2 No.79-2016, Cellular Metal and Cellular Concrete Floor Raceways and Fittings.

.2 CSA S16-14, Design of Steel Structures.

.3 CSA S136-12, North American Specification for the Design of Cold Formed Steel Structural Members including Update No. 1 (2014), Update No. 2. (2014), Update No. 3 (2015).

.4 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel Structures.

.5 CSA W55.3-09(R2014), Certification of Companies for Resistance Welding of Steel and Aluminum.

.6 CSA W59-13, Welded Steel Construction, (Metal Arc Welding) including Update No. 1 (2014), Update No. 3 (2015), Update No. 4 (2015).

.4 Green Seal Environmental Standards (GS)

.1 GS-11- Edition 3.2 (2015), Paints and Coatings.

.5 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

.1 SCAQMD Rule 1113- 2016, Architectural Coatings.

.2 SCAQMD Rule 1168- A2005, Adhesives and Sealants Applications.

.6 NACE International

.1 NACE International

.1 ANSI/NACE No. 13/SSPC-ACS-1- 2016 -SG, Industrial Coating and Lining Application Specialist Qualification and Certification.

1.5 DESIGN REQUIREMENTS

.1 Design steel deck to CSA S136 and CSSBI 10M .

.2 Design composite steel deck to CSA S16, CSA S136, and CSSBI 12M.

.3 Steel deck and connections to steel framing to carry dead, live and other loads including lateral loads, diaphragm action, composite deck action, and uplift as indicated.

.4 Maximum working stress under full live and dead loads shall not exceed 140 MPa.

.5 Live load deflection shall not exceed 1/240 of span.

.6 Roof deck shall provide building stability through diaphragm action.

.7 Where vibration effects controlled as indicated, dynamic characteristics of decking system designed in accordance with CSA S16.

1.6 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 steel decking and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit 2 copies of WHMIS SDS in accordance with Section 01 35 29.06 - Health and Safety Requirements and 01 35 43 - Environmental Procedures.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.

.2 Submit design calculations if requested by Contract Administrator.

.3 Indicate deck plan, profile, dimensions, base steel thickness, anchorage, metallic coating designation, connections to supports and spacings, projections, openings, reinforcement, closures, flashings, details and accessories.

.4 Indicate details of temporary shoring of steel deck, such as location, time and duration of placement and removal of shoring for concrete fill decks.

.4 Certificates:

.1 Submit certifications for Application Specialists to demonstrate compliance to the requirements of ANSI/NACE No.13.

1.7 QUALITY ASSURANCE

.1 Retain professional engineer registered or licensed in Manitoba, Canada, with experience in steel deck Work of comparable complexity and scope, to perform following services as part of Work of this Section:

.1 Structural design of steel deck.

.2 Review, stamp, and sign Shop, shoring and erection Drawings, design calculations, and revisions required.

.3 Conduct on-site inspections and prepare and submit inspection reports verifying this part of Work in accordance with Contract Documents and reviewed Shop Drawings. Perform inspections minimum of once per month.

.4 Monitor supplier's and fabricator's quality control tests and reports.

.2 Qualifications:

.1 Maintain a current and valid ACS certification during project period.

.1 Application specialists who perform surface preparation and coating application work on this project must have a current ACS.

.2 Notify Contract Administrator of any change in application specialist certification status.

.1 Any delays to the completion of the Project due to invalid certifications will not be considered, and liquidated damages shall not be waived for any non-performance by Contractor.

1.8 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

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

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

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

.1 Metal: galvanized sheet steel conforming to ASTM A446, Grades A or B as shown in Manufacturers' current literature

.2 Primer: zinc dust/zinc oxide alkyd type, conforming to CAN/CGSB-1.181, compatible with finish painting.

2.2 DECK AND RELATED ACCESSORIES

.1 Roof deck: minimum 0.76 mm thickness or as indicated on the Drawings, base sheet steel, galvaneal, three (3) equal spans, 38 mm deep profile

.2 Closure strips, flashing, and cover plates: minimum 0.76 mm thickness base sheet steel, galvaneal coating, of required profiles and sizes

2.3 FABRICATION

.1 Fabricate metal deck in accordance with requirements of CSA S136, and CSSBI Standards and Drawings.

.2 Fabricate deck with interlocking side laps.

.3 Fabricate to generally span over three or more supports unless shown otherwise on the Drawings.

Part 3 Execution

3.1 EXAMINATION

.1 Before starting erection, take field measurements and examine other Work which may affect this Work.

.2 Notify the Contract Administrator of any conditions which would prejudice proper installation of this Work.

.3 Commencement of this Work implies acceptance of existing conditions.

3.2 DAMAGED MEMBERS

.1 Repair or replace sections damaged during transit or erection before securing in position.

3.3 INSTALLATION

.1 Erect metal deck in accordance with requirements of CSSBI and the Drawings. Align and level deck on structural supports.

.2 Locate all end joints over supports.

.3 Lap all end joints on non-cellular deck 75 mm minimum.

.4 Maintain minimum end bearing on steel supports of 38 mm for deck up to 45 mm deep.

.5 Maintain minimum end bearing on masonry supports of 100 mm for deck up to 45 mm deep.

.6 Lay out lines of supporting steel on top surface of deck to produce accurate welds and prevent burns through deck from improper weld location.

.7 Welding shall be done by qualified welders who shall make practice welds. Prior to actual job welding, practice welds shall be made on the deck to be used to check adequacy of the welding rod amperage and burn-off rate to produce satisfactory fusion for the various welds required. Both the practice welds and actual job welds shall be inspected by the steel deck erector as to size and spacing and tested by pry tests to assure metal to metal fusion.

.8 Fasten to all supports with 20 mm diameter fusion welds at 300 mm on center maximum. Provide extra welds where indicated on the Drawings.

.9 Mechanically fasten sidelaps at 600 mm on center by button punch.

.10 Install angle or channel closures full length on all deck edges at perimeter, walls, and openings.

.11 Install acoustical closures over all walls and partitions.

.12 Cut all holes required in deck for drains, vents, mechanical equipment, ducts, and conduits.

.13 Reinforce openings up to 450 mm in any dimension with 55 x 55 x 6 mm steel angles. Place reinforcing angles at right angles to ribs, extend out two ribs each side and weld.

.14 Install deck to provide flat upper surface, with all flange surfaces touching a 1200 mm straight edge over structural supports.

.15 If two or more adjacent flanges on any deck section are concave or convex so that only edges or crowns touch straight edge, repair or replace deck sections.

.16 Immediately after installation, touch up welds, burned areas, and damaged areas of zinc coating with primer paint.

3.4 FIELD TOUCH-UP PAINTING

.1 Upon erection completion, mechanically brush clean bolts, rivets, welds, and burned or scratched surfaces.

.2 For galvanized steel surface with damage and without shop coat, repair with field touch up primer.

3.5 CLEANING

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

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

3.6 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by steel decking installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 05 12 23 – Structural Steel for Buildings

1.2 WORK INCLUDED

.1 Shop fabricated ferrous metal items, galvanized and prime painted. The following is a list of principal items only. Refer to Drawings for items not specifically listed.

.2 Roof framing – perimeter angles as indicated (painted)

.3 Bearing plates for steel joists (painted)

.4 Exterior masonry supports (galvanized)

.5 Loose lintels (galvanized)

.6 Angles and bearing plates for metal deck (painted)

.7 Steel Platforms

.8 Interior stairs, landings, and guard rails.

.9 Exterior stairs and railing.

.10 Anchors, plates, bolts, nuts, screws, brackets, chains, etc., required for Work of this Section

1.3 REFERENCE STANDARDS

.1 ASTM International (ASTM)

.1 ASTM A 53/A 53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

.2 ASTM A 307-14, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.2 CSA Group (CSA)

.1 CSA G40.20-13 /G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 CAN/CSA G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

.3 CSA S16-14, Design of Steel Structures.

.4 CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding (Developed in co-operation with the Canadian Welding Bureau).

.5 CSA W59-13, Welded Steel Construction (Metal Arc Welding) [Metric]

.3 The Master Painters Institute (MPI)

.1 Architectural Painting Specification Manual - current edition

.4 Underwriters Laboratories (UL)

.1 UL 2768-11, Architectural Surface Coatings

.5 NACE International

.1 NACE International

.1 ANSI/NACE No. 13/SSPC-ACS-1-2016 -SG, Industrial Coating and Lining Application Specialist Qualification and Certification.

.6 National Building Code of Canada 2010.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for sections, plates, pipe, tubing, bolts and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit two copies of WHMIS SDS in accordance with Section 01 35 29.06 - Health and Safety Requirements and 01 35 43 - Environmental Procedures.

.1 For finishes, coatings, primers, and paints applied on site: indicate VOC concentration in g/L.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.

.2 Indicate profiles, sizes, materials, core thicknesses, finishes, connections, attachments, size and type of fasteners, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.

.3 Coordinate with steel joist supplier for any connections to joists.

.4 Include erection drawings, elevations, and details where applicable.

.5 Indicate welded connections using CISC standard welding symbols. Clearly indicate net weld lengths.

.4 Certificates:

.1 Submit certifications for Application Specialists to demonstrate compliance to the requirements of ANSI/NACE No.13.

1.5 QUALITY ASSURANCE

.1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.

.2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.3 Qualifications:

.1 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 1 or 2.1.

.2 Ensure that specialists, who perform concrete and steel surfaces preparation and coating applications, are certified by a recognized Applicator Certification

Agency, in accordance with NACE 13 /SSPC ACS-I, Applicator Certification Standard (ACS).

.3 Maintain a current and valid ACS certification during project period.

.1 Application specialists who perform surface preparation and coating application work on this project must have a current ACS.

.4 Notify Contract Administrator of any change in application specialist certification status.

.1 Any delays to the completion of the Project due to invalid certifications will not be considered, and liquidated damages shall not be waived for any non-performance by Contractor.

1.6 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

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

.2 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

.1 Steel: conforming to CAN/CSA-G40.21; Type W with minimum yield strength of 350 MPa

.2 Welding materials: conforming to CSA W59

.3 Bolts, nuts, and washers: conforming to ASTM A325

.4 Accessories: anchors, plates, bolts, nuts, screws, brackets, etc., material to be compatible with items

.5 Accessories: wall brackets, with plaster rings, flanges, escutcheons, pre-formed bends, tee fittings, flush end caps, plugs, flush splice connectors; of same material and finish to match railings and hand railings

2.2 FINISHES

.1 Primer: CISC/CPMA 2-75

.2 Galvanizing: conforming to CAN/CSA-G164; Galvalume for touch-up

.3 Specialty chemical-resistant coating: see Section 099112 for product description and for surface preparation requirements. See drawings for steel to receive speciality coating

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. Cut off bolts flush with nuts.

.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 if 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.

.11 Thoroughly clean all surfaces of rust, scale, grease, and foreign matter prior to prime painting or galvanizing.

.12 Galvanize and prime paint items as shown. Do not shop prime surfaces in contact with or embedded in concrete or requiring field welding.

Part 3 Execution

3.1 EXAMINATION

.1 Before starting erection, examine other Work which may affect this Work.

.2 Notify the Contract Administrator of any conditions which would prejudice proper installation of this Work.

.3 Commencement of erection Work implies acceptance of existing conditions.

3.2 ERECTION

.1 Obtain Contract Administrator’s permission prior to site cutting or making adjustments which are not part of scheduled Work.

.2 Install items plumb, square and level, fit 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. All visible field welds shall be smooth; grind or file if required.

.6 Perform necessary cutting and altering for the installation of Work of other Sections, and as indicated on Drawings. No additional cutting is to 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 prime painted surfaces. Field touch-up primer shall be same as shop primer. Touch up galvanized surfaces with galvalume.

.9 Supply, to appropriate Sections, items required to be cast into concrete and built into masonry, complete with necessary setting templates.

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 metal fabrications installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 03 30 00 – Cast-in-Place Concrete

.2 04 22 00 – Concrete Unit Masonry

.3 07 13 52 – Modified Bituminous Sheet Waterproofing

1.2 WORK INCLUDED

.1 Roof parapets

.2 Blocking in wall

.3 Wood furring and grounds

.4 Concealed wood blocking for support of items and equipment supported by walls

.5 Wood treatment

1.3 REFERENCE STANDARDS

.1 American National Standards Institute/National Particleboard Association (ANSI/NPA)

.1 ANSI/NPA A208.1-2009 Particleboard.

.2 ASTM International (ASTM)

.1 ASTM A 123/A 123M-15, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.2 ASTM A 153/A 153M-09 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

.3 ASTM A 307-14 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength.

.4 ASTM A 653/A 653M-15, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.5 ASTM D 5456-14b, Standard Specification for Evaluation of Structural Composite Lumber Products.

.6 ASTM F 1667-13 Standard Specification for Driven Fasteners: Nails, Spikes and Staples.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-11.3-M87, Hardboard.

.2 CAN/CGSB-71.26-M88, Adhesive for Field-Gluing Plywood to Lumber Framing for Floor Systems.

.4 Canadian Wood Council

.1 Wood Design Manual 2010 (R2014) Edition

.2 Engineering Guide for Wood Frame Construction 2014

.5 CSA Group (CSA)

.1 CAN/CSA-A123.2-03(R2013), Asphalt Coated Roofing Sheets.
.2 CSA B111-1974 (R2003), Wire Nails, Spikes and Staples.
.3 CSA O86-14 Engineered Design in Wood
.4 CSA O112.9-10, Evaluation of Adhesives for Structural Wood Products (Exterior Exposure).
.5 CSA O121-08(R2013), Douglas Fir Plywood.
.6 CSA O141-05(R2014), Softwood Lumber.
.7 CSA O151-09(R2014), Canadian Softwood Plywood.
.8 CSA O153-13, Poplar Plywood.
.9 CSA O325-07(R2012), Construction Sheathing.

.6 National Lumber Grades Authority (NLGA)

.1 Standard Grading Rules for Canadian Lumber 2010.

.7 National Research Council Canada (NRC)

.1 National Building Code of Canada 2010 (NBC).

.8 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S706-09, Standard for Wood Fibre Insulating Boards for Buildings.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for wood products and accessories and include product characteristics, performance criteria, physical size, finish and limitations.
.2 Include manufacturer's pre-engineered floor, ceiling and roof joist span charts, and manufacturer's pre-engineered installation details.
.3 Submit certified test reports for prefabricated structural members from approved independent laboratory indicating compliance with specifications for specified performance characteristics and physical properties.
.4 Submit CCMC Product Evaluation Report for engineered wood products.
.5 Submit manufacturer's installation instructions.

.3 Shop Drawings:

.1 For structural applications or conditions beyond the scope of the manufacturer's pre-engineered design information, submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
.2 Include on drawings:
.1 Design data in accordance with CAN/CSA-O86 and CWC Engineering Guide for Wood Frame Construction.
.2 Indicate configuration and spacing of joists, hanger and connector types, fasteners, locations and design values; bearing details.
.3 Submit stress diagrams or print out of computer design indicating design loads for members. Indicate allowable load and stress increase.

.4 Indicate arrangement of webs or other members to accommodate ducts and other specialties.

1.5 DELIVERY, STORAGE, AND HANDLING

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

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

.3 Storage and Handling Requirements:

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

.2 Store materials off ground with moisture barrier at both ground level and as a cover forming a well-ventilated enclosure, with drainage to prevent standing water.

.3 Store wood I-beams and I-joists on edge.

.4 Stack, lift, brace, cut and notch engineered lumber products in strict accordance with manufacturer's instructions and recommendations.

.5 Store and protect architecturally exposed lumber from nicks, scratches, and blemishes.

.6 Replace defective or damaged materials with new.

.7 Store separated reusable wood waste convenient to cutting station and work areas.

Part 2 Products

2.1 MATERIALS

.1 Softwood lumber: CSA O141, non-structural light grading 19% maximum moisture content.

.2 Plywood: CSA O121M - Douglas fir CSA O151M - softwood type, with waterproof glue.

.3 Fasteners: Electro Hot dipped galvanized steel for exterior, high humidity, and treated wood locations; plain finish elsewhere; size and type to suit condition.

.4 Anchors: Toggle bolt type for anchorage to hollow masonry expansion shield and lag belt type for anchorage to solid masonry or concrete bolts or ballistic fasteners for anchorages to steel.

2.2 WOOD TREATMENT

.1 Wood preservative pressure treatment: CSA O80M using waterborne preservative with 0.30 percent retainage, manufactured by Wolman.

Part 3 Execution

3.1 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.

3.2 INSTALLATION

.1 Erect wood framing members level and plumb.

.2 Space framing and furring as noted on the Drawings.

.3 Construct curb members of single pieces.

.4 Curb all roof openings except where prefabricated curbs are provided. Form corners by lapping side members alternately.

.5 Provide blocking, sized to suit, for support of surface mounted accessories and equipment.

.6 Provide wood blocking around each door frame opening.

.7 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.

.8 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.

.9 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. Place perpendicular to framing members.

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 WASTE MANAGEMENT

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

.2 Re-use scrap lumber to the greatest extent possible. Separate scrap lumber for use on site as accessory components, including shims, bracing, and blocking.

.3 Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill. Prevent saw dust and wood shavings from entering the storm drainage system.

.4 Do not burn scrap lumber that has been pressure treated.

.5 Do not send lumber treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by rough carpentry installation.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

.1 Supply and installation of the following FRP items:

- .1 Grating at EL 100 000 for Building 101 (Ferric Chloride Chemical Storage Building) and Building 102 (Sodium Hydroxide Chemical Storage Building)
- .2 FRP grating for Railcar Shelter Unloading Platform
- .3 Guardrail around containment pit access hatches
- .4 Containment pit access ladders
- .5 Safety gates

1.2 REFERENCE STANDARDS

.1 ASTM International (ASTM)

- .1 ASTM D-638 14, Tensile Properties of Plastics
- .2 ASTM D-790 17, Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
- .3 ASTM D-2344/D-2344-16 16, Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Grating:

- .1 Submit Shop Drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit two samples of each type of grating.
- .3 Submit a colour chart of the standard range of colours.

.2 Guardrails and ladders:

- .1 The Contractor shall furnish manufacturer's shop drawings clearly showing material sizes, types, styles, part or catalog numbers, complete details for the fabrication of and erection of components including, but not limited to, location, lengths, type and sizes of fasteners, clip angles, member sizes, and connection details. Shop drawings to be sealed by a Professional Engineer registered in the Province of Manitoba, Canada.

- .2 The Contractor shall submit the manufacturer’s published literature including structural design data, structural properties data, corrosion resistance tables, certificates of compliance, test reports as applicable.

1.4 DELIVERY, STORAGE, AND HANDLING

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

.2 Manufactured materials shall be delivered in original, unbroken pallets, packages, containers, or bundles bearing the label of the manufacturer. Adhesives, resins and their

catalysts and hardeners shall be crated or boxed separately and noted as such to facilitate their movement to a dry indoor storage facility.

.3 Storage and Handling Requirements:

.1 All materials shall be carefully handled to prevent them from abrasion, cracking, chipping, twisting, other deformations, and other types of damage. Store items in an enclosed area and free from contact with soil and water. Store adhesives, resins and their catalysts, and hardeners in dry indoor storage facilities between 20 and 27 degrees Celsius until they are required.

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

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

.1 Grating

.1 Manufacture: grating components shall be high strength and high stiffness molded elements having a maximum of 70% and a minimum of 60% glass content (by weight) of continuous roving and continuous strand mat fiberglass reinforcements. The finished surface of the product shall be provided with a surfacing veil to provide a resin rich surface which improves corrosion resistance and resistance to ultraviolet degradation. Grating to be resistant to Ferric Chloride (38 percent) and Hydrochloric Acid (<5%). Grating to be manufactured with vinyl ester resins.

.2 Fire rating: grating shall be fire retardant with a tested ASTM E84 flame spread rating of 25 or less when tested in accordance with ULC S102. Manufacturer may be required to provide certification of ULC S102 test on grating panels from an independent testing laboratory. Certification shall be dated within the past two years. Test data shall be from full scale testing of actual production grating, of the same type and material supplied on the project. Test data performed only on the base resin shall not be acceptable.

.3 The manufacture of the grating may be required to submit corrosion data from tests performed on actual grating products in standard chemical environments. Corrosion resistance data of the base resin from the manufacturer is not a true indicator of grating corrosion resistance and shall not be accepted.

.4 Surfacing: grating shall be concave finished.

.5 Hardware: stainless steel Type 316 hold-down saddle clips, minimum 4 per panel.

.6 Size: grating shall be moulded bi-directional 38 mm by 38 mm and 38 mm height.

.7 Colour: to be selected from the manufacturer’s standard range of colours.

.8 Acceptable products: Precision Grate CF by Precisioneering and Fibregrate Vi-Corr by StonCor Firbergrate or approved equal in accordance with B8.

.2 Guardrails (interior, around containment pit access ladder)

.1 Guardrail and/or Handrail system to be DynaRound by Fibergrate Composite Structures or approved equal in accordance with B8.

.2 All posts and rails are to be DYNAFORM FRP structural shapes manufactured by the pultrusion process or approved equal in accordance with B8. The structural shapes shall be composed of fiberglass reinforcement and resin in qualities,

quantities, properties, arrangements and dimensions as necessary to meet the design requirements and dimensions specified in the Contract Documents.

.3 Fiberglass reinforcement shall be a combination of continuous roving, continuous strand mat, and surfacing veil in sufficient quantities as needed by the application and/or physical properties required.

.4 Resin shall be DYNAFORM VEFR, fire retardant vinyl ester with chemical formulation or approved equal in accordance with B8 necessary to provide the corrosion resistance, strength and other physical properties as required.

.5 All finished surfaces of FRP items and fabrications shall be smooth, resin-rich, free of voids and without dry spots, cracks, crazes or unreinforced areas. All glass fibers shall be well covered with resin to protect against their exposure due to wear or weathering.

.6 All pultruded structural shapes shall be further protected from ultraviolet (UV) attack with 1) integral UV inhibitors in the resin, 2) a synthetic surfacing veil to help produce a resin rich surface, and 3) an appropriate UV resistant coating for outdoor exposures.

.7 All FRP products shall have a tested flame spread rating of 25 or less per ASTM E-84 Tunnel Test.

.8 Horizontal rails and vertical posts for guardrails are to be 48.3 mm O.D x 5.1 mm wall round tube and the kick plate is to be x 101.6 mm deep x 3.2 mm thick with two reinforcing corrugations. Offset rail used as handrail is to be 38.1mm O.D. x 6.4mm wall round tube.

.9 The completed guardrail installation shall meet the following load requirements with a minimum factor of safety of 2.0:

Concentrated Load: 200 lb (891 N) applied in any direction at any point on the top rail.
Uniform Load: 50 lb/lf (730.5 N/m) applied in any direction on the top rail.
Loads are assumed not to act concurrently.

.10 All rails, posts, and kick plates are to be integrally pigmented yellow.

.11 The pultruded 48.3mm O.D. x 5.1mm wall round tube is to have the minimum longitudinal mechanical properties listed below:

Property	**ASTM Method**	**Value**	**Units**
Flexural Strength (Full Section)	---	70,000 (482)	psi (MPa)
Flexural Modulus (Full Section)	---	5.0×10^6 (34.4)	psi (GPa)
Short Beam Shear (Transverse)	D-2344	4,500 (31)	psi (MPa)
Shear Modulus (Transverse)	N/A	4.5×10^5 (3.1)	psi (GPa)
Density	D792	0.062 – 0.070 (1.71 – 1.93)	lb/in^3 (g/cc)
Coefficient of Thermal Expansion	D-696	8.0×10^{-6} (1.4×10^{-6})	in/in/°F (cm/cm/°C)
Flame Spread	E-84	25 or less	N/A

.12 All fasteners used in the railing system are to be AISI 316 stainless steel. Rivets and rivet nuts are to be AISI 304 stainless steel.

.3 Ladders

.1 Ladder and cage components shall be Dynarail by Fibergrate Composite Structures or approved equal in accordance with B8

.2 All ladder side rails, rungs, ladder mounting brackets and cage straps are to be FRP structural shapes manufactured by the pultrusion process. Cage hoops and brackets shall be produced by the open molded hand lay-up method. All structural shapes shall be composed of fiberglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements and dimensions as specified in the Contract Documents.

.3 Fiberglass reinforcement shall be a combination of continuous roving, continuous strand mat, bi-directional roving mat and surfacing veil in sufficient quantities as needed by the application and/or physical properties required.

.4 Resins shall be DYNAFORM VEFR, a vinyl ester with chemical formulation or approved equal in accordance with B8 necessary to provide the corrosion resistance, strength and other physical properties as required.

.5 All finished surfaces of FRP items and fabrications shall be smooth, resin-rich, free of voids and without dry spots, cracks, crazes or unreinforced areas. All glass fibers shall be well covered with resin to protect against their exposure due to wear or weathering.

.6 All pultruded ladder components shall be further protected from ultraviolet (UV) attack with 1) integral UV inhibitors in the resin and 2) a synthetic surfacing veil to help produce a resin rich surface

.7 All FRP products shall have a tested flame spread rating of 25 or less per ASTM E-84 Tunnel Test.

.8 The ladder side rail shall be 44.5mm square tube with a wall thickness of 6.4mm or greater. The rungs shall be 31.8mm diameter pultruded structural shapes, continuously fluted to provide a non-slip surface. Rungs that are gritted as a secondary operation shall not be permitted. Ladder wall and floor mount shall be fabricated from pultruded angles, 9.5mm minimum thickness.

.9 The ladder cage vertical bars shall be 38.1mm wide by 15.9mm pultruded I-beam shapes to offer protection to workers from exposed hardware. Cage hoops and cage brackets shall be manufactured by the open mold hand lay-up process. All cage hoops shall be 76.2mm wide by 6.4mm thick minimum.

.10 Type 316 stainless steel bolts shall be provided for attaching ladder cage vertical bars to hoops, ladder hoops to brackets, ladder cage brackets to the ladder, and wall brackets to the ladder.

.11 All rungs shall be both mechanically attached to the ladder with stainless steel rivets and chemically bonded with epoxy.

.12 All ladder and cage components are to be integrally pigmented yellow.

.13 Pultruded structural shapes used in the ladder system are to have the minimum longitudinal mechanical properties listed below:

Property	ASTM Method	Value	Units
Tensile Strength	D-638	30,000 (206)	psi (MPa)
Tensile Modulus	D-638	2.5×10^6 (17.2)	psi (GPa)
Flexural Strength	D-790	30,000 (206)	psi (MPa)
Flexural Modulus	D-790	1.8×10^6 (12.4)	psi (GPa)
Flexural Modulus (Full Section)	N/A	2.8×10^6 (19.3)	psi (GPa)
Short Beam Shear (Transverse)	D-2344	4,500 (31)	psi (MPa)
Shear Modulus (Transverse)	N/A	4.5×10^5 (3.1)	psi (GPa)
Coefficient of Thermal Expansion	D-696	8.0×10^{-6} (1.4×10^{-6})	in/in/°F (cm/cm/°C)
Flame Spread	E-84	25 or less	N/A

.14 All fasteners used in the ladder system are to be 316 SS. Rivets will be 18-8 stainless steel.

.4 Safety Gates

.1 Width: 820mm or adjustable

.2 Safety gate to be manufactured from FRP.

.3 Safety gate to be designed to be attached to guardrail and be able to swing 90 degrees.

.4 Gate to self-close using gravity.

.5 Safety gate system shall be designed to withstand 1 kN concentrated force horizontally.

.6 Gate hardware to be 316 Stainless steel

.7 Acceptable products: GraviGate by Poly-Tech or approved equal in accordance with B8

Part 3 Execution

3.1 FABRICATION

.1 Guardrails

.1 The post/rail connections for the 48.3mm O.D. x 5.1mm wall guardrail system are to be fabricated using molded, glass reinforced saddle connectors. The saddle connectors are to be attached to the tubes via bonding and riveting. The saddle connectors are to be connected to the adjoining tubes or connectors with 316SS 6.4mm diameter bolts and/or 304SS rivet nuts as required. No sharp, protruding edges are to remain after assembly of the railing system. No PVC or CPVC connectors are to be used as a load carrying component of the railing system. Spacing of the posts for horizontal runs is not to exceed 1220 mm. Spacing of posts for inclined runs and offset handrail supports shall not exceed 1070 mm.

.2 The bases of guardrail posts are to be secured according to the contract drawings. The bases of the posts are to be internally reinforced to a height of 216 mm. Posts are to be detailed with drain features that prevent the accumulation of water inside of the posts.

.3 The 38.1mm O.D. x 6.4mm wall round tube offset handrail is to be installed at a height of 863 mm above the walking surface and/or stair nosings and extend beyond the upper and lower treads as required to comply with governing building codes. The ends of the offset handrail are to terminate via a smooth, molded transition into the guardrail or wall. The offset handrails are to be attached to guards or walls with brackets fabricated from 316 stainless steel and/or FRP components. The configuration of the offset handrail brackets is to meet all NBCC 2010 graspability requirements.

.4 For inline splices, the 48.3mm O.D. x 5.1mm wall horizontal rails are to be spliced using a 152.4 mm length of 38.1 O.D. x 6.4mm FRP round tube bonded and riveted into place using epoxy adhesive. Inline splices for offset handrail to be a 127 mm length of 25.4mm diameter FRP solid round rod.

.5 For 90-degree splices, both the 48.3mm O.D. x 5.1mm wall horizontal rails and the 38.1mm OD x 6.4mm wall round tube offset handrail are to be spliced using a specially molded component which smoothly transitions between the spliced tubes with a constant radius. The spliced tubes are to be bonded and riveted to this molded 90-degree splice.

.6 For non-90-degree splices, both the 48.3mm O.D. x 5.1mm wall horizontal rails and the 38.1mm O.D. x 6.4mm wall round tube offset handrail are to be connected using a molded adjustable splice which can be adjusted to an included angle of 180 to 39 degrees. The ends of the spliced tube are to be mitered to achieve a minimum-gap butt joint. The spliced tubes are to be bonded and riveted to the molded splice.

.7 All shop fabricated cuts are to be sealed to provide maximum corrosion resistance. Field cuts are to be similarly coated by the contractor in accordance with the manufacturer's instructions.

.2 Ladders

.1 All ladders and cages shall be designed and laid out in strict accordance with OSHA 1910.27.

.2 All rungs shall penetrate the wall of the tube side rails and shall be connected to the rails with both epoxy and rivets to provide both a chemical and mechanical lock, respectively.

.3 Ladders shall be fully shop assembled. Ladder cages shall be test assembled and drilled to ensure a proper fit in the field. Ladder cage brackets shall remain attached to the ladder for shipping, but ladder cage components shall be disassembled, packaged, and shipped separately to ensure the lowest freight costs and to prevent damage in transit. Cage components shall be bundled with each respective ladder.

.4 The hoop brackets shall be shop attached to the ladder with bolts. The hoops shall be field attached to the hoop brackets.

.5 All cut or machined edges, holes and notches shall be sealed to provide maximum corrosion resistance. All field fabricated cuts shall be coated similarly by the contractor in accordance with the manufacturer's instructions.

.6 The completed ladder and cage system installation shall meet the following load requirements set forth in OSHA 1910.27. The ladder shall also be capable of supporting a concentrated vertical load of 5kN applied at the mid-span of the rung. Manufacturer shall be required to provide supporting test data for rung capacity.

3.2 EXAMINATION

.1 Before starting erection, examine other Work which may affect this Work.

.2 Notify the Contract Administrator of any conditions which would compromise proper installation of this Work.

.3 Commencement of erection Work implies acceptance of existing conditions.

3.3 INSTALLATION

.1 Grating

.1 Grating shall be installed in accordance with manufacturer's Shop Drawings. Lock grating panels securely in place with hold-down fasteners as specified herein. Field cut and drill panels with carbide or diamond tipped bits and blades. Seal cut or drilled surfaces in accordance with manufacturer's instructions; provide adequate ventilation.

.2 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.

.3 Grating shall meet the minimum dimensional requirements as shown or specified. The Contractor shall provide and/or verify measurements in field for work fabricated to field conditions as required by grating manufacturer. Determine correct size and locations of required holes or cutouts from field dimensions before grating fabrication.

.4 Each grating section shall be readily removable, except where indicated on Drawings. Manufacturer to provide openings and holes where located on the Drawings. Grating supports shall be provided at openings in the grating by contractor where necessary to meet load/deflection requirements specified herein. Grating openings which fit around protrusions (pipes, cables, machinery, etc.) shall be discontinuous at approximately the centerline of opening so each section of grating is readily removable. Gratings shall be fabricated free from warps, twists, or other defects which affect appearance and serviceability.

.5 All shop fabricated grating cuts and drilled holes shall be coated with vinyl ester resin to provide maximum corrosion resistance. All field fabricated grating cuts and drilled holes

.6 shall be coated similarly by the Contractor in accordance with the manufacturer's instructions.

.7 Hold-down clips shall be provided and spaced at a maximum of 1000 mm apart with a minimum of four per piece of grating, or as recommended by the manufacturer.

.2 Ladders

.1 Contractor shall be required to assemble and install ladder in strict accordance with manufacturer's assembly drawing and installation brochure.

.2 Seal cut or drilled surfaces in accordance with manufacturer's instructions. Follow manufacturer's instructions when cutting or drilling fiberglass products or using resin products; provide adequate ventilation.

3.4 CLEANING

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

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 03 10 00 – Concrete Forming and Accessories

.2 03 30 00 – Cast-In-Place Concrete

1.2 WORK INCLUDED

.1 Clean and prepare surfaces to receive dampproofing.

.2 Apply dampproofing to all exterior surfaces of exterior walls from 50 mm below finished grade levels or as shown on the Drawings down to top of piles.

.3 Caulk junction of walls and footings and around pipes and services entering through walls.

1.3 REFERENCE STANDARDS

.1 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB-37.2-M88, Emulsified Asphalt, Mineral-Colloid Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings.
- .2 CAN/CGSB-37.3-M89, Application of Emulsified Asphalts for Dampproofing or Waterproofing.
- .3 CAN/CGSB-37.5-M89, Cutback Asphalt Plastic Cement.
- .4 CGSB 37-GP-6Ma-83, Asphalt, Cutback, Unfilled, for Dampproofing.
- .5 CGSB 37-GP-9Ma-83, Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing.
- .6 CGSB 37-GP-11M-76(R1984), Application of Cutback Asphalt Plastic Cement.
- .7 CGSB 37-GP-12Ma-84, Application of Unfilled Cutback Asphalt for Dampproofing.
- .8 CGSB 37-GP-15M-76(R1984), Application of Asphalt Primer for Asphalt Roofing, Dampproofing and Waterproofing.
- .9 CAN/CGSB-37.16-M89, Filled, Cutback, Asphalt for Dampproofing and Waterproofing.
- .10 CAN/CGSB-37.28-M89, Reinforced Mineral Colloid Type, Emulsified Asphalt for Roof Coatings and for Waterproofing.
- .11 CGSB 37-GP-36M-76, Application of Filled Cutback Asphalts for Dampproofing and Waterproofing.
- .12 CGSB 37-GP-37M-77, Application of Hot Asphalt for Dampproofing or Waterproofing.

.2 CSA Group (CSA)

- .1 CAN/CSA-A123.4-04(R20018), Asphalt for Construction of Built-Up Roof Coverings and Waterproofing Systems.

.3 Health Canada

- .1 Workplace Hazardous Materials Information System (WHMIS)
  - .1 Safety Data Sheets (SDS).

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

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

.2 Submit 2 copies of WHMIS SDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

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

.2 Provide and maintain dry, off-ground weatherproof storage.

.3 Store and protect dampproofing materials from nicks, scratches, and blemishes.

.4 Store materials on supports to prevent deformation.

.5 Remove only in quantities required for same day use.

.6 Replace defective or damaged materials with new.

1.6 ENVIRONMENTAL REQUIREMENTS

.1 Do not proceed with Work when wind chill effect would tend to set bitumen before proper curing takes place.

.2 Maintain air temperature and substrate temperature at dampproofing installation area above 5°C for twenty-four (24) hours before, during and twenty-four (24) hours after installation, or as recommended by Manufacturer.

.3 Do not apply dampproofing in wet weather.

Part 2 Products

2.1 MATERIALS

.1 Asphalt: to CAN/CGSB-37-GP-16Ma. Acceptable Products: Bakelite/Flintguard 710-11 Foundation Coating and Elsro 505 Fibrated Foundation Coating or approved equal in accordance with B8.

.2 Asphalt primer: to CAN/CGSB 37-GP-9Ma. Acceptable Products: Bakelite/ Flintguard 910- 01 Asphalt Primer and Elsro 510 Asphalt Primer or approved equal in accordance with B8.

.3 Sealing compound: plastic cutback asphalt cement to CAN/CGSB-37.5. Acceptable Products: Bakelite/Flintguard 770-05, Elsro recommended sealing compound or approved equal in accordance with B8.

Part 3 Execution

3.1 APPLICATION

.1 Apply dampproofing Products in one (1) coat in accordance with the Manufacturer's written instructions.

.2 Thoroughly clean concrete surfaces with wire brushes to remove dirt and loose scale before applying dampproofing.

.3 Seal exterior joints between foundation walls and footings, and around penetrations through dampproofing with sealing compound.

.4 Apply primer.

.5 Apply dampproofing evenly by brush or spray in one application, completely covering surfaces with no bare spots. Application shall be inspected by the Contract Administrator before backfilling commences.

.6 Apply dampproofing at the rate of one (1) litre/m^2.

.7 Apply two (2) additional coats of dampproofing to vertical corners and construction joints for a minimum width of 230 mm on each side, and 230 mm minimum width around pipes passing through walls.

3.2 CLEANING

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

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

3.3 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by dampproofing application.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 07 11 13 - Bituminous Dampproofing

.2 07 62 00 - Sheet Metal Flashing and Trim

.3 07 92 00 - Joint Sealants

1.2 WORK INCLUDED

.1 Conventional, 2-ply, modified bituminous roofing.

1.3 REFERENCE STANDARDS

.1 ASTM International Inc.

.1 ASTM C 726 - 17, Standard Specification for Mineral Fiber Roof Insulation Board.

.2 ASTM C 728 – 17a, Standard Specification for Perlite Thermal Insulation Board.

.3 ASTM D 41 - 16, Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.

.4 ASTM D 448 - 12, Standard Classification for Sizes of Aggregate for Road and Bridge Construction.

.5 ASTM D 449 -03, Standard Specification for Asphalt Used in Dampproofing and Waterproofing.

.6 ASTM D 2178 – 15a, Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing.

.7 ASTM D 6162 - 21, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fibre Reinforcements.

.8 ASTM D 6163 - 21, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fibre Reinforcements.

.9 ASTM D 6164 - 21, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements.

.10 Modified, Bituminous, Prefabricated, and Reinforced for Roofing.

.2 Canadian Roofing Contractors Association (CRCA)

.1 CRCA Roofing Specifications Manual-2011.

.3 CSA Group (CSA)

.1 CSA-A123.3 -05 (R2020), Asphalt Saturated Organic Roofing Felt.

.2 CSA-A123.4 -04 (R2020), Asphalt for Constructing Built-Up Roof Coverings and Waterproofing Systems.

.3 CSA A231.1/A231.2 -19, Precast Concrete Paving Slabs/Precast Concrete Pavers.

.4 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S701 -17, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.2 CAN/ULC-S702.2 -10, Standard for Mineral Fibre Thermal Insulation for Buildings.

.3 CAN/ULC-S704 -17, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

.4 CAN/ULC-S706 -09 (R2020), Standard for Wood Fibre Thermal Insulation for Buildings.

1.4 SYSTEM DESCRIPTION

.1 Conventional roof system: two-ply torched on conventional SBS membrane system with insulation and gypsum board on steel deck.

1.5 QUALIFICATIONS

.1 Applicator: company specializing in performing the Work of this Section with three (3) years documented experience and approved by system Manufacturer.

.2 Work of this Section to conform to Manufacturer's instructions.

1.6 MANUFACTURER'S REPRESENTATIVE

.1 The roofing material Manufacturer shall delegate a representative to visit the Work at commencement of Work and periodically during Work in progress.

.2 At all times permit and facilitate access to the Work Site and roofs to the Manufacturer's Representative.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store, protect, and handle Products to Site under provisions of the General Specifications Section.

.2 Deliver Products in Manufacturer's original containers, dry, undamaged, seals and labels intact.

.3 Store Products in weather-protected environment, clear of ground and moisture.

.4 Stand roll materials on end.

1.8 ENVIRONMENTAL REQUIREMENTS

.1 Do not apply roofing membrane during inclement weather.

.2 Do not apply roofing membrane to damp or frozen deck surface.

.3 Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during the same day.

1.9 FIRE PROTECTION

.1 Prior to the start of work, conduct a site inspection to ensure its safety in order to minimize fire risks and hazards.

.2 Respect safety measures recommended by the related local authorities.

.3 At the end of each workday, use a heat detector gun to spot any smoldering or concealed fire. Job planning must be organized to ensure workers are still on location at least two (2) hours after welding works. An inspection must be performed by an employee of the roofing contractor with appropriate training and experience at the end of works and, if necessary, with the help of a member of the fire protection service.

.4 Never apply the torch directly to flammable materials.

.5 Throughout roofin installation, maintain a clean site and have a fire hose (when possible) and at least one (1) ULC-approved Class A, B, or C fire extinguisher, charged and in perfect operating condition, within 6m (20ft) of each torch. Respect all safety measures described in technical data sheets of sealants. Welding torches must never be placed near combustible or flammable products, nor be used where the flame is not visible or cannot be easily controlled.

1.10 WARRANTY

.1 Provide warranty in accordance with General Specification but for a period of ten (10) years.

.2 The membrane manufacturer will issue a written and signed document in the Owner's name, certifying that the rooming membranes are free of manufacturing defects, warranted for a period of ten (10) years starting from the date of completion of membrane installation. This warranty will cover the removal and replacement of defective roof membrane products, including workmanship. The warranty must remain full and complete for the duration of the period stated, with these requirements noted in the warranty certificate.

.3 The Contractor will provide a RCAM certificate of warranty for this project, valid for a period of five (5) years.

Part 2 Products

2.1 MEMBRANE MATERIALS

.1 Vapour Barrier

.1 Description: Thermofusible vapour barrier with a thickness of 3.5mm composed of SBS modified bitumen and a non-woven polyester reinforcement. The surface is to be sanded and the underface covered with a thermofusable plastic film.

.2 Acceptable Product: Sopralene 180 SP 3.5 by Soprema or approved equal in accordance with B8.

.2 High-Density Polyisocyanurate Board and Base Sheet Membrane

.1 Description: Board composed of SBS modified bitumen membrane with a polyester reinforcement, factory-laminated on a high-density polyisocyanurate board. Board dimensions 0.91m x 2.44m (3ft x 8ft). Surface to be covered with thermofusible plastic film. Membrane side lap provided with DUO SELVEDGE technology. Thickness: 15mm

.2 Acceptable Product: 2-1 Sprasmart ISO HD by Soprema or approved equal in accordance with B8.

.3 Base Sheet Membrane for Flashings and Parapets

.1 Description: Membrane composed of SBS modified bitumen and composite heavy-duty reinforcement. The surface is to be covered with a thermofusible plastic film and the underside with a release protection film. The surface shall be marked with chalk lines to ensure proper roll alignment.

.2 Acceptable Product: Sopraply Flam Stick by Soprema or approved equal in accordance with B8.

.4 Roofing Cap Sheet Membrane for Field Surfaces, Flashings, Parapets, and Walkways

.1 Description: Roofing membrane composed of SBS modified bitumen with a composite reinforcement and elastomeric bitumen. The surface is to be protected by colored granules with the underface protected by a thermofusible plastic film.

.2 Acceptable Product: Sopraply Traffic Cap by Soprema or approved equal in accordance with B8.

.5 Cover Strip

.1 Description: Membrane strip measuring 330mm (13in) composed of SBS modified bitumen with a composite reinforcement to ensure water-tightness in the end laps. Faces are to be covered with a plastic thermofusible film.

.2 Acceptable Product: Sopralap by Soprema or approved equal in accordance with B8.

2.2 SHEET MATERIALS

.1 Gypsum board: CSA A82.27, sheathing grade, 13 thick, uncoated faces, fire rated.

2.3 INSULATION

.1 CAN/ULC S704, polyisocyanurate board composed of a closed cell polyisocyanurate foam core between polymer-coated glass fibre facers.

.1 Acceptable Product: Sopra-Iso Plus by Soprema or approved equal in accordance with B8. Total thickness of 178 mm.

.2 Sloped, Type 2 expanded polystyrene board. Minimum thickness: 13mm.

.1 Acceptable Product: PlastiSpan HD by Plasti-Fab, or approved equal in accordance with B8.

2.4 PRIMERS

.1 Primer for Self-Adhesive Membranes

.1 Description: Primer composed of SBS synthetic rubber, adhesive resins and volatile solvents. Used as primer to improve the adhesion of self-adhesive membranes.

.2 Acceptable Product: Elastocol Stick by Soprema or approved equal in accordance with B8.

.3

.2 Primer for Thermofusible Membranes

.1 Description: Primer made from bitumen, fast-evaporating solvents and adhesive enhancing additives.

.2 Acceptable Product: Elastocol 500 by Soprema or approved equal in accordance with B8.

2.5 ADHESIVES

.1 Insulation Adhesive

.1 Description: Two-component, quick-setting, low-expansion foam urethane adhesive.

.2 Acceptable Product: Duotack by Soprema or approved equal in accordance with B8.

2.6 COMPLIMENTARY WATERPROOFING PRODUCTS

.1 Waterproofing Mastic

.1 Description: Multi-purpose mastic composed of SBS modified bitumen, fibres, mineral fillers and solvents. Sopramastic by Soprema or approved equal in accordance with B8.

.2 Acceptable Product: Sopramastic by Soprema or approved equal in accordance with B8.

.3 Description: Polyester-based resin, single-component, moisture cure elastomer sealing mastic and adhesive.

.4 Acceptable Product: Sopramastic SP2 by Soprema or approved equal in accordance with B8.

.2 Pitch Pocket Filler

.1 Description: Polyester-based precast blocks of various sized from a single-component, moisture cure elastomer sealing mastic and adhesive.

.2 Acceptable Product: Sopramastic Block System by Soprema or approved equal in accordance with B8.

.3 Sealing Product

.1 Description: Bitumen/polyurethane waterproofing mono-component resin and polyester reinforcement.

.2 Acceptable Product: Aslan Flashing and Polyfleece by Soprema or approved equal in accordance with B8.

Part 3 Execution

3.1 SURFACE EXAMINATION AND PREPARATION

.1 Surface examination and preparation to be completed in accordance with membrane manufacturer’s technical specifications.

.2 Surfaces to be clean, smooth, dry, and free of ice and debris. Use of calcium or salt for ice or snow removal is forbidden.

3.2 METHOD OF EXECUTION

.1 Protect building surfaces against damage from roofing work.

.2 Ensure waterproofing of roofs at all times, including protection during work performed by other trades (vent or drain installation, etc.)

.3 Protect exposed surfaces of finished work to avoid damage. Install walkways using rigid boards over installed roofing sections.

.4 Roofing work must be completed in a continuous fashion as surfaces are readied and as weather conditions allow it. No materials will be installed during rain or snowfall.

.5 Joints not yet covered by a cap sheet membrane are to be sealed each day to prevent moisture ingress.

.6 Installation of vapour barrier support panels on steel deck:

.1 Install support panel using mechanical fasteners in accordance with and spaced as required by CSA A123.21 testing report.

.2 Cut board with straight lines such that edges rest on centre of upper ribs.

.3 Stagger board joints at half-length, butted.

.7 Application of Primer:

.1 Wooden, metallic, concrete and masonry surfaces or gypsum insulation substate to receive a coat of primer at application rate required by manufacturer. All surfaces to be primed must be free of rust, dust, and all residue that may hinder adherence. Primed surfaces must be covered with roofing membrane as soon as possible, including on same day for use of self-adhesive membranes.

.8 Application of Thermofusible Vapour Barrier:

.1 Primer must be dry prior to installation of vapour barrier membrane.

.2 Start installation at lowest point of roof slope. Heat-weld vapour barrier membrane to substrate in accordance with manufacturer's recommendations.

.3 Overlap adjacent rolls of 75mm and 100mm. Ends laps to be 150 mm, spaced by minimum 300mm.

.4 Vapour barrier to meet and overlap the air/vapour barrier on adjoining walls with full continuity. Pull up vapour barrier at insulation perimeter and around each penetrating element to ensure sealed connections with flashing base sheet.

.9 Installation of Insulation Boards and Factory-Laminated Base Sheet

.1 Adhere insulation boards and base sheet board using adhesive applied in continuous strips. Spaced as required by CSA A123.21 testing report.

.2 All boards must be completely adhered to the surface without significant variances in level. Damaged boards not accepted for use.

.3 Adhere first section of self-adhesive side laps using a membrane roller. Finish with heat-welding (self-adhesive, heat-welded side laps).

.4 Seal end laps by welding a 330mm wide protection strip centered on joint.

.5 Avoid formation of wrinkles, swellings, or fishmouths.

.10 Installation of Self-Adhesive Base Sheet on Flashings and Parapets

.1 If there is an overlap (inside and outside corners and field surface) burn plastic film from section to be covered prior to applying membrane. For sanded base sheet membranes apply primer for self-adhesive membrane on area to be covered at foot of parapet.

.2 Allow primer coat to dry prior to application of base sheet membrane.

.3 Install base sheet in strips 1m wide.

.4 Overlap selvedge along marked lines along length and by 150mm at ends. Membranes for flashings to be spaced minimum of 100mm with respect to cap sheet membranes on the field surface to avoid areas of excess thickness.

.5 Cut off corners at end laps of areas to be covered by next roll.

.6 Position pre-cut membrane. Remove 150mm of silicone release film to hold membrane in place at top of parapet. Pell of remaining silicone release film while pressing down with applicator to ensure good adhesion. Ensure transition between flashing and field surface is fit precisely. Smooth membrane surface with roller to ensure full adhesion.

.7 Install reinforcing gusset at all inside and outside corners.

.8 Seal overlaps at end of each workday.

.9 Avoid the formation of wrinkles, swellings or fishmouths.

.11 Installation of Reinforced Gussets

.1 Install reinforcing gussets at all inside and outside corners.

.2 Heat-weld gussets in place after installation of base sheet membrane.

.12 Installation of Roof Drains

.1 Burn plastic film of the section to be covered by roof drain.

.2 Insert drain sleeve into rainwater drainage opening on the roof.

.3 Remove release protection film and adhere flexible deck flange to the base sheet membrane of the field surface. Apply pressure using membrane roller to ensure adherence.

.4 Seal perimeter of the flexible deck flange with a torch and round nosed trowel. Heat-weld the cap sheet membrane on the roof drain flexible deck flange. Allow to cool prior to cutting roof drain hole.

.5 Position strainer at upper rainwater drainage opening of roof drain. Insert drain and slide legs of the strainer into the sleeve of the roof drain, adjusting to correct diameter. Tighten upper screws to fix the legs and tighten side screws to hold strainer in place.

.13 Installation of Vent Stacks

.1 Burn plastic film of section to be covered by the vent stack.

.2 Insert aluminum vent sleeve over main plumbing system.

.3 Remove release protection film and adhere the flexible deck flange to the base sheet membrane of the field surface. Apply pressure using membrane roller to ensure adherence.

.4 Seal perimeter of the flexible deck flange with a torch and round nosed trowel.

.5 Insulate the space between the main plumbing vent system and the aluminum vent sleeve.

.6 Insert and position adjustable flashing into the aluminum vent sleeve. The adjustable flashing must be seated on the main plumbing vent system.

.7 Heat-weld the cap sheet membrane on the roof drain flexible deck flange. Allow to cool prior to cutting.

.8 Install and affix aluminum rain cap on aluminum vent sleeve.

.14 Installation of Thermofusible Cap Sheet on Field Surface

.1 Begin with double-selvedge starter roll. If starter roll is not used, side-laps covered with granules must be de-granulated by embedding granules in bitumen over 75mm width.

.2 Unroll membrane on base sheet, taking care to align the edge of the first selvedge with the edge of the roof.

.3 Cut off corners and end laps at areas to be covered by the next roll.

.4 Overlap selvedge along lines provided for installation and 150mm at ends. Space end laps a minimum of 300mm.

.5 Heat-weld cap sheet membrane with a torch on the base sheet to create a bleed-out of 3mm-6mm.

.6 Be careful to not overhead membrane or reinforcements during installation.

.7 Avoid formation of wrinkles, swellings, or fishmouths.

.8 Avoid walking directly on finished surfaces.

.15 Installation of Thermofusible Cap Sheet on Flashings and Parapets

.1 Cap sheet to be installed in 1m wide strips.

.2 Overlap selvedge along lines provided for installation and 150mm at ends. Space minimum of 100mm with respect to cap sheet membranes on the field surface to avoid areas of excess membrane thickness.

.3 Cur off corners at end laps on areas to be covered by the next roll.

.4 Use a chalk line to draw straight lines on field surface, 150mm from flashings and parapets.

.5 Use a torch and round-nose trowel to embed the surface granules in a layer of hot bitumen, starting from the chalk line to the bottom edge of the flashing or parapet, as well as on granulated vertical surfaces to be overlapped.

.6 Cap sheet to be heat-welded directly to the base sheet membrane.

.7 Be careful to not overhead membrane or reinforcements during installation.

.8 Avoid formation of wrinkles, swellings, or fishmouths.

.16 Installation of Pitch Pockets

.1 Surfaces to be clean, dry, and free of debris, dust, non-adhered particles, oil, corrosion or other contaminants, as well as condensation.

.2 Metal surfaces and PVC pipes to be cleaned with non-greasy solvents eg. acetone or methyl ethyl ketone (MEK).

.3 Lay out precast blocks around penetration ensuring minimum gap of 25mm between the block inner wall and the penetration. Trace outline.

.4 Seal base of penetration with sealant and adhesive using a standard cartridge extruder. Cover penetration with sealant minimum of 25mm above height of precast blocks.

.5 Apply 6mm bead of sealant under and at ends of precast blocks, around perimeter and at the center of the surface.

.6 Place and align blocks on the roof outline. Apply pressure on the precast blocks until product overflows along all sides.

.7 Apply bead of sealant to block joints and at outer perimeter of the block structure. Bond the sealant and adhesive to the membrane using a trowel.

.8 Completely fill horizontal surfaces with sealing mastic.

.9 Completely fill vertical surfaces with sealant and adhesive.

.17 Installation of Walkways

.1 Install walkways in compliance with requirements for cap sheet installation. Apply primer to cap sheet prior to installing walkways.

3.3 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 conform to their documented instructions.

.3 Repair or replace defaced or disfigured finish due to Work of this Section.

3.4 PROTECTION

.1 Protect building surfaces against damage from roofing Work.

.2 Where traffic must continue over finished roof membrane, protect surfaces.

3.5 COORDINATION WITH OTHER TRADES

.1 Coordinate with electrical and mechanical sub-trades for making all penetrations through roofing weather- and moisture-tight.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 04 22 00 – Concrete Unit Masonry

.2 07 92 00 - Joint Sealants

1.2 REFERENCE STANDARDS

.1 Canadian General Standards Board (CGSB)

.1 CGSB 71-GP-24M-AMEND-77(R1983), Adhesive, Flexible, for Bonding Cellular polystyrene Insulation.

.2 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S604-2012, Standard for Factory-Built Type A Chimneys.

.2 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Coverings.

.3 ASTM

.1 ASTM E 96/E 96M-13, Standard Test Methods for Water Vapour Transmission of Materials.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet for board insulation and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit WHMIS SDS - Safety Data Sheets in accordance with Section 01 35 29.06 - Health and Safety Requirements.

.3 Quality Assurance Submittals: submit following in accordance with Section 01 33 00 – Submittal Procedures.

.1 Submit certified test reports showing compliance with specified performance characteristics and physical properties.

.2 Submit manufacturer's installation instructions.

1.4 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

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

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

.3 Replace defective or damaged materials with new.

1.5 WASTE MANAGEMENT AND DISPOSAL

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

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

1.6 AMBIENT CONDITIONS

.1 Install solvent curing sealants and vapour release adhesive materials in open spaces with ventilation.

.2 Ventilate enclosed spaces in accordance with Section 01 51 00 - Temporary Utilities.

.3 Maintain temperature and humidity recommended by materials manufactures before, during and after installation.

1.7 SEQUENCING

.1 Sequence work to permit installation of materials in conjunction with related materials and seals.

Part 2 Products

2.1 INSULATION

.1 Extruded polystyrene (XPS): to CAN/ULC-S701

.1 Type: 4.

.2 Compressive strength: 25 psi

.3 Thickness: as indicated.

.4 Size: Largest practical size available for application.

.5 Edges: square.

2.2 ACCESSORIES

.1 Insulation clips: impale type, perforated 50 x 50 mm cold rolled carbon steel 0.8 mm thick, adhesive back, spindle of 2.5 mm diameter annealed steel, length to suit insulation, 25 mm diameter washers of self-locking type.

Part 3 Execution

3.1 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 GENERAL

3.3 EXAMINATION

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

.2 Visually inspect substrate.

.3 Inform Contract Administrator of unacceptable conditions immediately upon discovery.

.4 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Contract Administrator.

3.4 INSTALLATION

.1 Install insulation after building substrate materials are dry.

.2 Install insulation to maintain continuity of thermal protection to building elements and spaces.

.3 Fit insulation tight around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows and other protrusions.

.4 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures, and minimum 50 mm from sidewalls of CAN/ULC-S604 type A chimneys and CSA B149.1 and CSA B149.2 type B and L vents.

.5 Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.

.6 Offset both vertical and horizontal joints in multiple layer applications.

.7 Do not enclose insulation until it has been inspected and approved by the Contract Administrator

3.5 RIGID INSULATION INSTALLATION

.1 Imbed insulation boards into vapour barrier type adhesive, applied as specified, prior to skinning of adhesive.

3.6 PERIMETER INSULATION

.1 Exterior application: extend boards below finish grade as indicated. Install on exterior face of perimeter foundation wall with adhesive.

.2 Exterior application: extend boards 1200 mm from perimeter foundation walls. Slope boards away from foundation on compacted fill.

3.7 CAVITY WALL INSTALLATION

.1 Install expanded polystyrene insulation boards on outer surface of inner wythe of wall cavity over impaling clips.

.2 Leave insulation board joints unbonded over line of expansion and control joints. Bond a continuous 150mm wide modified bituminous membrane over expansion and control joints using compatible adhesive and primer before application of insulation.

3.8 CLEANING

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

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.9 PROTECTION OF WORK

.1 Protect finished work in accordance with manufacturer’s recommendations].

.2 Do not permit adjacent work to damage work of this section.

.3 Ensure finished work is protected from climatic conditions.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 07 62 00 – Sheet Metal Flashing and Trim

.2 07 92 00 - Joint Sealants

1.2 REFERENCE STANDARDS

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-19.13M-[M87], Sealing Compound, One Component, Elastomeric Chemical Curing.

.2 CAN/CGSB-19.24M-[M90], Multi-Component, Chemical Curing Sealing Compound.

.3 CGSB 19-GP-14M-[84], Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing.

.2 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC S741, Standard for Air Barrier Materials - Specification

.3 ASTM

.1 ASTM E2178-21a, Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeability of Building Materials

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit WHMIS SDS - Safety Data Sheets in accordance with Section 01 35 29.06 - Health and Safety Requirements.

.3 Quality Assurance Submittals: submit following in accordance with Section 01 33 00 – Submittal Procedures.

.1 Existing Substrate Condition: report deviations, as described in PART 3 -EXAMINATION in writing to Contract Administrator.

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

.3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.

.4 Manufacturer's Field Reports: submit manufacturer's written reports within [3] days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

1.4 QUALITY ASSURANCE

.1 Qualifications:

.1 Applicator: company specializing in performing work of this section with minimum 5 years documented experience with installation of air/vapour barrier systems.

.1 Completed installation must be approved by the material manufacturer.

.2 Applicator: company:

.1 Currently licensed by National Air Barrier Association.

.2 Must maintain their licence throughout the duration of the project.

.2 Site Meetings: as part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.

.1 After delivery and storage of products, and when preparatory Work is complete, but before installation begins.

.2 Twice during progress of Work at 25% and 60% complete.

.3 Upon completion of Work, after cleaning is carried out.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer’s requirements.

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

.3 Avoid spillage: immediately notify Contract Administrator if spillage occurs and start clean up procedures.

.4 Clean spills and leave area as it was prior to spill.

1.6 WASTE MANAGEMENT AND DISPOSAL

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

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

1.7 AMBIENT CONDITIONS

.1 Install solvent curing sealants and vapour release adhesive materials in open spaces with ventilation.

.2 Ventilate enclosed spaces in accordance with Section 01 51 00 - Temporary Utilities.

.3 Maintain temperature and humidity recommended by materials manufactures before, during and after installation.

1.8 SEQUENCING

.1 Sequence work to permit installation of materials in conjunction with related materials and seals.

Part 2 Products

.1 Air/Vapour Barrier

.1 Description: Thermofusible air/vapour barrier for use in wall composed of SBS modified bitumen and a non-woven polyester reinforcement.

.2 Acceptable Product: Sopraseal 180 HD by Soprema or approved equal in accordance with B8.

2.2 SHEET MATERIALS

.1 Sheet Seal: thermofusable elastomeric bitumen membrane reinforced with a non-woven polyester reinforcement.

2.3 SEALANTS

.1 Sealants in accordance with Section 07 92 00 - Joint Sealants.

.2 Butyl Sealant: CGSB 19-GP-14M, butyl rubber base, single component, solvent release, non-skinning, Shore "A" Hardness Range of 10 to 30; black colour.

.3 Primer: recommended by sealant manufacturer.

.4 Substrate Cleaner: non-corrosive type recommended by sealant manufacturer and compatible with adjacent materials].

2.4 ACCESSORIES

.1 Thinner and cleaner for Butyl Sheet: as recommended by sheet material manufacturer.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 GENERAL

.1 Perform Work in accordance with Sealant and Waterproofer's Institute - Sealant and Caulking Guide Specification requirements for materials and installation.

.2 Perform Work in accordance with requirements for materials and installation.

3.3 EXAMINATION

.1 Verify that surfaces and conditions are ready to accept work of this section.

.2 Ensure surfaces are clean, dry, sound, smooth, continuous and comply with air barrier manufacturer's requirements.

.3 Report unsatisfactory conditions to Contract Administrator in writing.

.4 Do not start work until deficiencies have been corrected.

.1 Beginning of Work implies acceptance of conditions.

3.4 PREPARATION

.1 Remove loose or foreign matter, which might impair adhesion of materials.

.2 Ensure substrates are clean of oil or excess dust; masonry joints struck flush, and open joints filled; and concrete surfaces free of large voids, spalled areas or sharp protrusions.

.3 Ensure substrates are free of surface moisture prior to application of [self-adhesive] membrane and primer.

.4 Ensure metal closures are free of sharp edges and burrs.

.5 Prime substrate surfaces in accordance with manufacturer's instructions.

.1 Acceptable Product: Elastocol 500 by Soprema or approved equal in accordance with B8.

3.5 INSTALLATION

.1 Install materials in accordance with manufacturer's instructions.

.2 Secure sheet seal to masonry materials with heat bonding.

.1 Caulk with butyl sealant to ensure complete seal.

.2 Position lap seal over firm bearing.

.3 Lap sheet seal onto roof vapour retarder and seal with heat bonding.

.1 Caulk to ensure complete air seal.

.2 Position lap seal over firm bearing.

.4 Apply sealant within recommended application temperature ranges.

.1 Consult manufacturer when sealant cannot be applied within these temperature ranges.

3.6 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.7 CLEANING

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

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.8 PROTECTION OF WORK

.1 Protect finished work in accordance with manufacturer's recommendations].

.2 Do not permit adjacent work to damage work of this section.

.3 Ensure finished work is protected from climatic conditions.

3.9 SCHEDULES

.1 Wall Air/Vapour Barrier Over Outer Surface of Masonry:

.1 Seal masonry anchor penetrations air tight.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 07 11 13 – Bituminous Dampproofing

.2 07 13 52 – Modified Bituminous Sheet Waterproofing

1.2 WORK INCLUDED

.1 Parapet cap flashings

.2 Base/drip flashings

.3 Pre-finished Brake Metal

1.3 REFERENCE STANDARDS

.1 The Aluminum Association Inc. (AAI)

.1 AA Aluminum Design Manual 2015 Part VIII Guidelines for Aluminum Sheet Metal Work in Building Construction.

.2 AAI DAF45-2003(R2009), Designation System for Aluminum Finishes.

.2 American Architectural Manufacturers Association (AAMA)

.1 AAMA 611-14 Voluntary Specifications for Anodized Architectural Aluminum.

.2 AAMA 621-02 Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Substrates.

.3 AAMA 2603-15, Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.

.4 AAMA 2604-13 Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.

.5 AAMA 2605-13 Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

.3 American National Standards Institute (ANSI)

.1 ANSI/SPRI/FM 4435/ES-1, Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems 2011.

.4 ASTM International (ASTM)

.1 ASTM A 240/A 240M-16, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

.2 ASTM A 606/A 606M-15, Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance.

.3 ASTM A 653/A 653M-15e1, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.4 ASTM A 755/A 755M-16e1 Standard Specification for Steel Sheet, Metallic coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.

.5 ASTM A 792/A 792M-10(2015), Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

.6 ASTM B 32-08(2014), Standard Specification for Solder Metal.

.7 ASTM B 209-14 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.8 ASTM B 370-12, Standard Specification for Copper Sheet and Strip for Building Construction.

.9 ASTM D 523-14, Standard Test Method for Specular Gloss.

.10 ASTM D 1970/D 1970M-15a Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.

.11 ASTM D 4587-11 Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings.

.12 ASTM F 1667-15 Standard Specification for Driven Fasteners: Nails, Spikes and Staples.

.5 Canadian Roofing Contractors Association (CRCA)

.1 Roofing Specifications Manual 2012.

.6 Canadian Sheet Steel Building Institute (CSSBI)

.1 CSSBI S8-2008 Quality and Performance Specification for Prefinished Sheet Steel Used for Building Products.

.2 CSSBI B17-2002 Barrier Series Prefinished Steel Sheet: Product Performance & Applications.

.3 CSSBI Sheet Steel Facts #12 2003 Fastener Guide for Sheet Steel Building Products.

.7 CSA Group (CSA)

.1 CSA A123.3-05(2015), Asphalt Saturated Organic Roofing Felt.

.2 CSA A123.22-08(2013) Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.

.8 FM Global

.1 Property Loss Prevention Data Sheets 1-49 Perimeter Flashing.

.9 Green Seal Environmental Standards

.1 Standard GS-11-2015, Paints, Coatings, Stains, and Sealers.

.2 Standard GS-36-2013, Adhesives for Commercial Use.

.10 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Safety Data Sheets (SDS).

1.4 EXISTING CONDITIONS/PROTECTION

.1 Exercise care when working on or about roof surfaces to avoid damaging or puncturing membrane or flexible flashings.

.2 Place plywood panels on roof surfaces to Work of this Section and on access routes. Keep in place until completion of Work.

1.5 DELIVERY, STORAGE AND HANDLING

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

.2 Handle and store flashing materials to prevent creasing, buckling, scratching, or other damage.

Part 2 Products

2.1 SHEET METALS

.1 Galvanized steel: minimum 24-gauge core steel; conforming to requirements of ASTM A525 G90 Galvanized Coating.

.2 Prefinished galvanized flashing: ASTM A446; G90 zinc coating; 24-gauge core steel; shop precoated; Colour as per schedule.

2.2 ACCESSORY MATERIALS AND COMPONENTS

.1 Fasteners: concealed clip type, of same materials as flashings; sized to suit application.

.2 Rubber-asphalt sealing compound: conforming to requirements of CGSB 37-GP-5M.

.3 Bituminous paint: acid and alkali resistant type; black colour.

2.3 FABRICATION

.1 Fabricate metal flashings in accordance with recommendations of CRCA and as indicated on Drawings.

.2 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

.3 Form sections in 2438 mm (8 ft) lengths. Make allowances for expansion at joints.

.4 All seams are to be flat lock type except corners. Fabricate corners minimum 460 mm, mitred, soldered or welded, and sealed as one (1) piece.

.5 Hem exposed edges of flashings on underside 13 mm.

.6 Backpaint flashing with bituminous paint where expected to be in contact with cementitious materials or dissimilar metals. Fabricate scuppers as detailed.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, can't strips and reglets in place, and nailing strips located.

.2 Verify membrane termination and base flashings are in place, sealed, and secure.

.3 Beginning of installation means acceptance of existing conditions.

3.2 PREPARATION

.1 Field measure Site conditions prior to fabricating Work.

.2 Install starter and edge strips, and cleats before starting installation.

3.3 INSTALLATION

.1 Install flashings in accordance with CRCA recommendations and as indicated on Drawings.

.2 Secure flashing in place using concealed type fasteners. Use exposed fasteners in locations approved by the Contract Administrator only. When using exposed fasteners, they are to be of the same finish as flashings.

.3 Apply sealing compound at junction of metal flashings and asphalt felt flashings.

.4 Lock seams and end joints. Fit flashing tight in place. Make corners square, surfaces true and straight in all planes and all lines accurate to profiles.

.5 Counter-flash all mechanical and electrical items projecting through.

.6 Install galvanized flashing to all locations indicated on Drawings.

.7 Install pre-finished flashing to all locations indicated on Drawings.

.8 Seal metal joints watertight.

3.4 CLEANING

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

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

.3 Leave work areas clean, free from grease, finger marks and stains.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 05 31 00 – Steel Decking

1.2 WORK INCLUDED

.1 Supply and installation of all sealant and backing materials as required.

1.3 REFERENCE STANDARDS

.1 ASTM International (ASTM)

.1 ASTM C 919-18, Standard Practice for Use of Sealants in Acoustical Applications.

.2 Canadian General Standards Board (CGSB)

.1 CGSB 19-GP-5M-1984, Sealing Compound, One Component, Acrylic Base, Solvent Curing (Issue of 1976 reaffirmed, incorporating Amendment No. 1).

.2 CAN/CGSB-19.13-M87, Sealing Compound, One-component, Elastomeric, Chemical Curing.

.3 CGSB 19-GP-14M-1984, Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing (Reaffirmation of April 1976).

.4 CAN/CGSB-19.17-M90, One-Component Acrylic Emulsion Base Sealing Compound.

.5 CAN/CGSB-19.24-M90, Multi-component, Chemical Curing Sealing Compound.

.3 General Services Administration (GSA) - Federal Specifications (FS)

.1 FS-SS-S-200-E(2)1993, Sealants, Joint, Two-Component, Jet-Blast-Resistant, Cold Applied, for Portland Cement Concrete Pavement.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Safety Data Sheets (SDS).

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

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

.2 Manufacturer's product to describe:

.1 Caulking compound.

.2 Primers.

.3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.

.3 Submit 2 copies of WHMIS SDS in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 CLOSEOUT SUBMITTALS

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

.2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.

1.6 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

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

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

.3 Replace defective or damaged materials with new.

1.7 ENVIRONMENTAL CONDITIONS

.1 Sealant and substrate materials to be minimum 5

.6 Acceptable Product: Emseal “Grayflex” or approved equal in accordance with B8.

.3 Bond breaker: pressure sensitive plastic tape, which will not bond to sealants.

.4 Sealants

.1 Sealant shall be UV-resistant and ozone resistant, capable of supporting their own weight, conforming to CAN2-19.13.

.2 Sealants for vertical and horizontal non-traffic bearing joints, to Table 1, CGSB19-GP-23.

.3 Colour of sealants shall match adjacent surface. Colours to be selected by the Contract Administrator, from standard colour range.

.4 Joint cleaner: xylol, methylethylketone or non-corrosive type recommended by sealant Manufacturer and compatible with joint forming materials.

2.2 ACCEPTABLE PRODUCTS

.1 For all non-traffic bearing joints unless indicated otherwise Dow Corning No. 790 or approved equal in accordance with B8.

.2 For joints between exterior doors, windows, ductwork, etc., and adjacent materials: Dow Corning No. 795 or approved equal in accordance with B8.

Part 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 joint sizes and correct to achieve depth ratio one-half of joint width with minimum width and depth of 6 mm, maximum width 25 mm.

.6 Install joint filler to achieve correct joint depth.

.7 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.

.8 Apply bond breaker tape where required to Manufacturer’s instructions.

.9 Prime sides of joints in accordance with sealant Manufacturer’s instructions immediately prior to caulking.

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 door frames to adjacent building components, around perimeter of every external opening, to control joints in concrete slabs and where indicated.

3.3 CLEANING

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

.1 Leave Work area clean at end of each day.

.2 Clean adjacent surfaces immediately.

.3 Remove excess and droppings, using recommended cleaners as work progresses.

.4 Remove masking tape after initial set of sealant.

.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 joint sealants installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 08 71 00 - Door Hardware

.2 09 91 12 - Specialty Chemical-Resistant Painting

.3 09 91 23 - Interior Painting

1.2 WORK INCLUDED

.1 Non-rated and fire rated rolled steel frames

.2 Non-rated and fire rated hollow steel doors

1.3 REFERENCE STANDARDS

.1 ASTM International (ASTM)

.1 ASTM A 653/A 653M-06a, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 ASTM B 29-03, Standard Specification for Refined Lead.

.3 ASTM B 749-03, Standard Specification for Lead and Lead Alloy Strip, Sheet and Plate Products.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.2 CGSB 41-GP-19Ma-84, Rigid Vinyl Extrusions for Windows and Doors.

.3 CSA Group (CSA)

.1 CSA-G40.20-04 /G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 CSA W59-03, Welded Steel Construction (Metal Arc Welding).

.4 Canadian Steel Door Manufacturers' Association (CSDMA)

.1 CSDMA, Recommended Specifications for Commercial Steel Doors and Frames, 2000.

.2 CSDMA, Selection and Usage Guide for Commercial Steel Doors, 1990.

.5 National Fire Protection Association (NFPA)

.1 NFPA 80-99, Standard for Fire Doors and Fire Windows.

.2 NFPA 252-03, Standard Methods of Fire Tests of Door Assemblies.

.6 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S701-01, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.2 CAN/ULC-S702-97, Standard for Thermal Insulation, Mineral Fibre, for Buildings.

.3 CAN/ULC-S704-03, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

.4 CAN4-S104-M80, Standard Method for Fire Tests of Door Assemblies.

.5 CAN4-S105-M85, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN4-S104.

1.4 SYSTEM DESCRIPTION

.1 Design Requirements:

.1 Design exterior frame assembly to accommodate to expansion and contraction when subjected to minimum and maximum surface temperature of -35 degrees C to 35 degrees C.

.2 Maximum deflection for exterior steel entrance screens under wind load of 1.2 kPa not to exceed 1/175th of span.

.3 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN4-S104 for ratings specified or indicated.

.4 Provide fire labelled frames for openings requiring fire protection ratings. Test products in conformance with CAN4-S104 and listed by nationally recognized agency having factory inspection services.

1.5 QUALITY ASSURANCE

.1 Conform to requirements of Canadian Steel Door and Frame Manufacturers Association Standards.

.2 Fire rated construction to conform to ULC standards.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

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

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

.3 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.

.2 Indicate on Shop Drawings, frame configuration, anchor types and spacings, location of cutouts for hardware, reinforcement and finish.

.3 Indicate on Shop Drawings, door elevations, internal reinforcement, and closure method, and location of cutouts for glazing.

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

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

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1 Macotta
.2 Allmar
.3 Shanahans
.4 Or approved equal in accordance with B8.

2.2 FRAMES

.1 Type/Size: as shown on Drawings and Schedules.
.2 Frames: 1.52 mm (16 gauge) cold rolled sheet steel with ZF75 Colourbond coating.
.3 Bumpers: Resilient rubber.
.4 Anchors: purpose made to rigidly secure frames, 3 per jamb.
.5 Mortar Guard Boxes: 0.76 mm (22 gauge) welded in place.
.6 Primer: zinc chromate type.
.7 Insulation: Sprayed-in Polyurethane Foam.

2.3 DOORS

.1 Insulated Core Doors: minimum 1.21 mm (18 gauge.) surface sheets, and top and bottom end channels; cores filled with insulation.

.2 Honeycomb Core Doors: minimum 1.21 mm (18 gauge) surface sheets and 1.21 mm (18 gauge) thick top and bottom end channels; cores filled with honeycomb material laminated under pressure to surface sheets.

.3 Reinforcement for hardware:

.1 Locks: minimum 1.52 mm (16 gauge) steel.
.2 Butts: minimum 3.42 mm (10 gauge) steel.
.3 Flush Bolts: minimum 3.42 mm (10 gauge) steel
.4 Door Closures: minimum 1.9 (14 gauge) mm steel.
.5 Door Holders: minimum 1.9 mm (14 gauge) steel.

2.4 FABRICATION - FRAMES

.1 Fabricate frames as welded unit.

.2 Fabricate frames with hardware reinforcement plates welded in place. Provide mortar guard boxes.

.3 Prepare frame for silencers. Provide three (3) single silencers for single doors and mullions of double doors on strike side, and two single silencers on frame head at double doors without mullions.

.4 Attach channel spreaders at bottom of frames for shipping.

.5 Reinforce exterior frames at lock side, to prevent frame distortion.

2.5 FABRICATION -DOORS

.1 Fabricate hollow metal doors and panels in accordance with requirements of "Canadian Manufacturing Standards for Steel Doors and Frames" produced by the Canadian Steel Door and Frame Manufacturer's Association and as indicated on Drawings.

.2 Fabricate fire rated hollow metal doors in accordance with requirements of ULC. Place ULC labels where visible when in installed position.

.3 All doors in fire rated walls shall be listed and labelled with a maximum temperature rise limitation of 250°C after 30 minutes in accordance with the National Building Code.

.4 Mechanically interlock longitudinal seams of honeycomb core type doors weld seams and sand flush. Top and bottom of doors closed with end channels recessed and spot welded in place.

.5 Reinforce and prepare doors to receive hardware. Refer to Section 08700 for hardware requirements.

.6 Each exterior hollow metal door to be supplied complete with a full length 3.42 mm (10 gauge) anti-intrusion plate welded to latch side of door.

Part 3 Execution

3.1 INSTALLATION

.1 Install doors and frames in accordance with Canadian Steel Door and Frame Manufacturers Association standards.

.2 Install roll formed steel reinforcement channels between two abutting frames. Anchor to structure and floor.

.3 After installation, touch up all scratched or damaged surface and prime.

.4 Insulate all frames exposed to the exterior.

3.2 TOLERANCES

.1 Maximum diagonal distortion: 2 mm measured with straight edge, corner to corner.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 08 11 00 – Metal Doors and Frames

.2 08 71 00 – Door Hardware

1.2 REFERENCE STANDARDS

.1 Aluminum Association (AA)

.1 AA DAF 45- 03(R2009), Designation System for Aluminum Finishes.

.2 ASTM International (ASTM)

.1 ASTM A 1008/A 1008M-10, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

.2 ASTM D 523-08, Standard Test Method for Specular Gloss.

.3 ASTM D 822-01(2006), Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.105-M91, Quick-Drying Primer.

.2 CAN/CGSB-1.213-04, Etch Primer (Pretreatment Coating or Tie Coat) for Steel and Aluminum.

.3 CAN/CGSB-1.181-99, Ready-Mixed, Organic Zinc-Rich Coatings.

.4 CSA Group (CSA)

.1 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

1.3 SUBMITTALS

.1 Product Data: submit manufacturer's product data and installation instructions for each type of sectional door. Include both published data and any specific data prepared for this project.

.2 Shop Drawings: submit Shop Drawings for approval prior to fabrication. Include detailed plans, elevations, details of framing members, required clearances, anchors, and accessories. Include relationship with adjacent materials.

1.4 QUALITY ASSURANCE

.1 Manufacturer: sectional doors shall be manufactured by a firm with a minimum of five years experience in the fabrication and installation of sectional doors. Manufacturers proposed for use, which are not named in these specifications, shall submit evidence of ability to meet performance and fabrication requirements specified, and include a list of five projects of similar design and complexity completed within the past five years.

.2 Installer: installation of sectional doors shall be performed by the authorized representative of the manufacturer.

.3 Single-source responsibility: provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.

.4 Pre-installation conference: schedule and convene a pre-installation conference just prior to commencement of field operations, to establish procedures to maintain optimum working conditions and to coordinate this Work with related and adjacent Work.

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 sectional metal doors for incorporation into manual.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 Deliver materials and products in labeled protective packages. Store and handle in strict compliance with manufacturer’s instructions and recommendations. Protect from damage from weather, excessive temperatures and construction operations.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURER

.1 Provide sectional doors by Overhead Door Corporation, Dallas, Texas; Telephone 800-887- 3667, or approved equal in accordance with B8.

2.2 THERMACORE® INSULATED STEEL SECTION DOORS

.1 Trade Reference: 595 Series Thermacore® Insulated Steel Doors by Overhead Door Corporation.

.2 Sectional Door Assembly: metal-foam-metal sandwich panel construction, with EPDM thermal break and ship-lap design. Units shall have the following characteristics:

.1 Panel Thickness: 41 mm (1-5/8 inch)
.2 Exterior Surface: flush, textured.
.3 Exterior Steel: 20 gauge, hot-dipped galvanized.
.4 End Stiles: 16 gauge.
.5 Standard Springs: 10,000 cycles. (High cycles.)
.6 Insulation: CFC-free and HCFC-free polyurethane, fully encapsulated.
.7 Thermal Values: R-value of 14.86; U-value of 0.067.

.8 Air Infiltration: 0.0025 m^3/min at 27 km/h (0.09 cfm at 15 mph); 0.0023 m^3/min at 40 km/h (0.08 cfm at 25 mph).

.9 Sound Transmission: Class 26

.10 Pass-Door: not required

.11 High-Usage Package: not required

.12 Partial Glazing of Steel Panels: not required

.13 Full Glazing Requiring Aluminum Sash Panels: not required

.3 Finish and colour: two-coat baked-on polyester with white exterior and white interior colour.

.4 Windload design: ANSI/DASMA 102 standards and as required by code.

.5 Hardware: galvanized steel hinges and fixtures. Ball bearing rollers with hardened steel races.

.6 Lock: interior mounted slide lock

.7 Weatherstripping: EPDM rubber bulb-type strip at bottom, header seal and jamb weatherstripping

.8 Track: provide track as recommended by manufacturer to suit loading required and clearances available

.9 Manual operation: chain hoist

.10 Electric motor operation: provide UL-listed electric operator, size and type as recommended by manufacturer to move door in either direction at not less than 200 mm/s (8 inches/s) nor more than 300 mm/s (1 ft/s).

.1 Entrapment protection: pneumatic sensing edge up to 5486 mm wide.

.2 Operator controls: pushbutton operated control stations with open, close, and stop buttons for surface mounting, for interior location.

.11 Special operation: none.

Part 3 EXECUTION

3.1 PREPARATION

.1 Take field dimensions and examine conditions of substrates, supports, and other conditions under which this work is to be performed. Do not proceed with work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

.1 Strictly comply with manufacturer’s installation instructions and recommendations. Coordinate installation with adjacent work to ensure proper clearances and allow for maintenance.

.2 Instruct City’s personnel in proper operating procedures and maintenance schedule.

3.3 ADJUSTING AND CLEANING

.1 Test sectional doors for proper operation and adjust as necessary to provide proper operation without binding or distortion.

.2 Touch-up damaged coatings and finishes and repair minor damage. Clean exposed surfaces using non-abrasive materials and methods recommended by manufacturer of material or product being cleaned.

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

.1 Leave Work area clean at end of each day.

.4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

.1 Remove traces of primer; clean doors and frames.

.2 Clean glass and glazing materials with approved non-abrasive cleaner.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Not Applicable.

1.2 REFERENCE STANDARDS

.1 Aluminum Association (AA)

.1 Aluminum Standards and Data.

.2 ASTM International (ASTM)

.1 ASTM A 1008/A 1008M-05b, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

.2 ASTM A 653/A 653M-05a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.105, Quick-Drying Primer.

.2 CAN/CGSB-1.213, Etch Primer (Pretreatment Coating) for Steel and Aluminum.

.3 CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating.

.4 CAN/CGSB-12.12, Plastic Safety Glazing Sheets.

.5 CGSB 41-GP-6M, Sheets, Thermosetting Polyester Plastics, Glass Fiber Reinforced.

.4 CSA Group (CSA)

.1 CAN/CSA-G164-[M92(R1998)], Hot Dip Galvanizing of Irregularly Shaped Articles.

1.3 Submittals

.1 Product Data: submit manufacturer’s product data and installation instructions for each type of sectional door. Include both published data and any specific data prepared for this project.

.2 Shop Drawings: submit Shop Drawings for approval prior to fabrication. Include detailed plans, elevations, details of framing members, required clearances, anchors, and accessories. Include relationship with adjacent materials.

1.4 Quality Assurance

.1 Manufacturer: sectional curtains shall be manufactured by a firm with a minimum of five years experience in the fabrication and installation of sectional doors. Manufacturers proposed for use, which are not named in these specifications, shall submit evidence of ability to meet performance and fabrication requirements specified, and include a list of five projects of similar design and complexity completed within the past five years.

.2 Installer: installation of sectional curtains shall be performed by the authorized representative of the manufacturer.

.3 Single-source responsibility: provide curtains, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.

.4 Pre-installation conference: schedule and convene a pre-installation conference just prior to commencement of field operations, to establish procedures to maintain optimum working conditions and to coordinate this Work with related and adjacent Work.

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 sectional metal doors for incorporation into manual.

1.6 Delivery, Storage And Handling

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements 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 Deliver materials and products in labeled protective packages. Store and handle in strict compliance with manufacturer’s instructions and recommendations. Protect from damage from weather, excessive temperatures and construction operations.

Part 2 Products – Plastic Curtains

2.1 ACCEPTABLE MANUFACTURER

.1 Provide industrial plastic curtains by AKON Curtain and Divider or approved equal in accordance with B8. Refer to Sections 2.2 – 2.5 for further details.

2.2 SYSTEM INFORMATION

.1 Plastic curtain walls to provide protection against all exposed sides of equipment.

.1 Curtains to be four (4) sided when the protected equipment can be accessed from any side.

.2 Curtains to be two (2) sided when the equipment can only be accessed from two (2) sides and is cornered against two (2) wall sections.

.2 Plastic curtain’s height to extend upward to ceiling or space above. There should be a minimal gap between the space above and curtain height.

.3 Curtain to be manually operated by hand.

2.3 MATERIALS

.1 Plastic curtain to be primarily 20 mil thick, clear double polished PVC.

.1 Triple hem stitching to be used for longevity.

.2 Material to be NFPA and CFM fire retardant.

.3 Plastic curtain shall have tensile strength and elongation percentage in accordance with ASTM-D-882.

.4 Plastic curtain shall have tear strength and heat shrinkage percentage in accordance with ASTM-D-1004.

2.4 Track

.1 Track strut to be galvanized steel. The track should fully support the curtain.

.1 Support curtain from the track every five (5) feet.

.2 All cut edges should be fully deburred and free of sharp edges.

.3 Top roller carrier to be galvanized steel and offer height adjustments.

.4 Track to be hung from space above by threaded rod or beam clamps.

.1 Threaded rod to be 3/8”, Gr. 5, fully galvanized.

.5 Track to have curtain rollers with full floating grease packed hardened steel ball bearings.

.1 Bearings to be germanely lubricated.

.6 Roller brackets to be adjustable galvanized steel.

2.5 STANDARD DUTY INDUSTRIAL HARDWARE

.1 All hardware to be galvanized for corrosion resistance.

.2 Self tapping screws are not acceptable and should not be used when installing the track or curtain.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install doors and hardware.

.2 Touch-up with primer where galvanized finish damaged during fabrication.

.3 Install electrical motors, controller units, pushbutton stations, relays and other electrical equipment required for door operation.

.4 Installation includes electric wiring from power supply located near door opening.

.5 Lubricate springs and adjust door operating components to ensure smooth opening and closing of doors.

.6 Adjust weatherstripping to form weather tight seal.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

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

3.4 CLEANING

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

.2 At completion remove surplus and excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 08 11 00 – Metal Doors and Frames

1.2 WORK INCLUDED

.1 Hardware for hollow metal doors

.2 Thresholds and weatherstripping

1.3 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA)

.1 ANSI/BHMA A156.1-2000, American National Standard for Butts and Hinges.
.2 ANSI/BHMA A156.2-2003, Bored and Preassembled Locks and Latches.
.3 ANSI/BHMA A156.3-2001, Exit Devices.
.4 ANSI/BHMA A156.4-2000, Door Controls - Closers.
.5 ANSI/BHMA A156.5-2001, Auxiliary Locks and Associated Products.
.6 ANSI/BHMA A156.6-2005, Architectural Door Trim.
.7 ANSI/BHMA A156.8-2005, Door Controls - Overhead Stops and Holders.
.8 ANSI/BHMA A156.10-1999, Power Operated Pedestrian Doors.
.9 ANSI/BHMA A156.12-2005, Interconnected Locks and Latches.
.10 ANSI/BHMA A156.13-2002, Mortise Locks and Latches Series 1000.
.11 ANSI/BHMA A156.14-2002, Sliding and Folding Door Hardware.
.12 ANSI/BHMA A156.15-2006, Release Devices - Closer Holder, Electromagnetic and Electromechanical.
.13 ANSI/BHMA A156.16-2002, Auxiliary Hardware.
.14 ANSI/BHMA A156.17-2004, Self-closing Hinges and Pivots.
.15 ANSI/BHMA A156.18-2006, Materials and Finishes.
.16 ANSI/BHMA A156.19-2002, Power Assist and Low Energy Power - Operated Doors.
.17 ANSI/BHMA A156.20-2006, Strap and Tee Hinges and Hasps.

.2 Canadian Steel Door and Frame Manufacturers' Association (CSDMA)

.1 CSDMA Recommended Dimensional Standards for Commercial Steel Doors and Frames - 2009.

.3 Underwriters' Laboratories of Canada (ULC)

.1 ULC – List of Equipment and Materials, Volume 2.

1.4 COORDINATION

.1 Coordinate Work of this Section with other directly affected Sections involving Manufacturer of and internal reinforcement for door hardware.

.2 Supply templates to Manufacturers of components affected by hardware.

1.5 REGULATORY REQUIREMENTS

.1 Conform to applicable code for requirements applicable to fire rated doors, frames and hardware.

.2 Conform to ULC requirements for fire rated doors, frames and hardware.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Shop Drawings:

.1 Indicate on Shop Drawings, locations and mounting heights of each type of hardware.

.3 Product Data:

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

.4 Hardware List:

.1 Submit contract hardware list.

.2 Indicate specified hardware, including make, model, material, function, size, finish and other pertinent information.

.3 Hardware list shall list each door individually and shall list hardware for each door as a described item, not by a code as is done in the Specification. Hardware list shall be in terminology understandable by a layman.

.4 Submit one (1) copy of Manufacturers' catalogue cuts of each item, with hardware list.

.5 Put parts lists, Manufacturer’s instructions, and catalogue cuts into maintenance manual as per Section 01 33 00 – Submittal Procedures

.6 Supply templates to door and frame Manufacturer to enable accurate sizes, locations of cut outs, and reinforcement for hardware.

.7 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

.8 Manufacturer's Instructions: submit manufacturer's installation instructions.

1.7 CLOSEOUT SUBMITTALS

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

.2 Operation and Maintenance Data: submit operation and maintenance data for door hardware for incorporation into manual.

1.8 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Stock Materials:

.1 Supply maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

1.9 QUALITY ASSURANCE

.1 Regulatory Requirements:

.1 Hardware for doors in fire separations and exit doors certified by a Canadian Certification Organization accredited by Standards Council of Canada.

.2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.10 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 Package items of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.

.4 Storage and Handling Requirements:

.1 Store hardware in locked, dry area in individual packages or like groups.

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

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

.1 As per schedule on drawings.

.2 Use Products from a single Manufacturer for all similar items.

2.2 DOOR HARDWARE

.1 Butts: Provide 1-1/2 pair for all doors, except doors over 900 mm wide or over 2,200 mm high are to have two (2) pairs.

.2 Protective plates: supply to both sides of door unless otherwise specified.

2.3 FASTENERS

.1 Supply all fastening devices for installation and operation of hardware.

.2 All exposed fasteners to be finished to match hardware.

.3 Use fasteners compatible with material through which they pass.

2.4 KEYING

.1 Door locks: Use construction cylinders to allow for a grand master key system to match existing system by Medeco to be installed at a later date.

.2 Supply three (3) keys for each lock. Supply three (3) master keys for each group, and three (3) grand master keys.

Part 3 Execution

3.1 INSPECTION

.1 Verify that door and frame components are ready to receive Work and dimensions are as required.

.2 Beginning of installation means acceptance of existing conditions.

3.2 INSTALLATION

.1 Install hardware in accordance with Manufacturer's instructions.

.2 Install locksets as specified with construction cylinder for later installation of Medeco cylinder keying system by Contract Administrator.

.3 Use the templates provided by hardware item Manufacturer.

.4 Maintain the following mounting heights for doors, from finished floor to centre line of hardware item:

.1 Locksets: 1020 mm

.2 Dead locks: 1525 mm

.3 Exit devices: 1020 mm

3.3 SCHEDULE

.1 Refer to Architectural Drawings.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 03 30 00 Cast-In-Place Concrete

.2 05 12 23 Structural Steel for Buildings

1.2 WORK INCLUDED

.1 Coat structural steel at main floor level above containment pits of Ferric Chloride Storage Room and Sodium Hydroxide Building.

.2 Coat interior concrete face of containment pit in Ferric Chloride Storage Room and Sodium Hydroxide Building.

1.3 REFERENCE STANDARDS

.1 Environmental Protection Agency (EPA)

.1 Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, EPA Method 24 - Surface Coatings.

.2 SW-846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Safety Data Sheets (SDS).

.3 Master Painters Institute (MPI)

.1 The Master Painters Institute (MPI)/Architectural Painting Specification Manual (ASM) - current edition.

.2 Standard GPS-1-12, MPI Green Performance Standard.

.3 Standard GPS-2-12, MPI Green Performance Standard.

.4 National Research Council Canada (NRC)

.1 National Fire Code of Canada 2015 (NFC).

.5 Society for Protective Coatings (SSPC)

.1 SSPC Painting Manual, Volume Two, 8th Edition, Systems and Specifications Manual.

1.4 SUBMITTALS

.1 Prior to commencing work submit manufacturers technical data and installation instructions.

.2 Submit manufacturers certificate of compliance that the materials meet specification requirements.

.3 Submit two 150 x 150 samples of specified item.

1.5 DELIVERY AND STORAGE

.1 Materials shall be delivered to site in manufacturer’s original un-opened containers.

.2 Materials shall be stored indoors protected from damage moisture, direct sunlight and stored in temperatures as per manufacturer's specifications.

Part 2 Products

2.1 MANUFACTURER

.1 Acceptable Manufacturers:

Stonhard

AkzoNobel

Wasser

or approved equal in accordance with B8.

2.2 MATERIALS

.1 Concrete containment pit liner:

.1 Liner to provide chemical barrier for submerged condition to Ferric Chloride and Sodium Hydroxide solutions of concentrations of up to 40%.

.2 Acceptable product:

Stonchem 756 by Stonhard

Ceilcote 242MR by AkzoNobel

Polyflex 55 (in combination with MC-Universal 100 primer) by Wasser

or approved equal in accordance with B8.

.2 Structural steel coating (at main floor level above containment pit) and area of concrete slab below Railcar Shelter Unloading Platform (extent as show in the drawings):

.1 Coating to provide chemical barrier resistant to spills for Ferric Chloride and Sodium Hydroxide of concentrations of up to 40%.

.2 Acceptable product:

Ceilcote 242MR by AkzoNobel

Polyflex 55 (in combination with MC-Universal 100 primer) by Wasser

or approved equal in accordance with B8.

Part 3 Execution

3.1 PREPARATION

.1 Concrete liner:

.1 Concrete must have sufficient tensile strength (1.7 MPa). The surface must be clean and dry, physically sound and free of contamination. Surfaces must be free of holes, voids or defects. Cracks and abrupt changes in surface profile must not exceed 3.2 mm. Fins and projections must be removed. All curing compounds and sealers must be removed.

.2 Verify that the moisture content of substrate is within the acceptable range to flooring manufacturer.

.3 Contractor must report in writing, surfaces left in improper conditions by other trades.

.4 Application will constitute acceptance of surfaces by the applicator.

.5 Prepare all surfaces to receive coating according to contract documents by shot-blast or similar mechanical method as recommended by manufacturer.

.6 Patch all depressions divets honey-comb or scaled concrete with concrete filler as recommended by manufacturer.

.2 Steel coating:

.1 Prepare steel as per manufacturer's recommendations.

3.2 INSTALLATION

.1 Comply with manufacturer's recommendations for preparation, priming, and coatings application including mil thicknesses.

.2 Application:

.1 Concrete liner:

Apply to containment pit base slab, sump pit base slab, pit wall interior surfaces and sump pit wall interior surfaces for both Building 101 (Ferric Chloride Chemical Storage Building) and Building 102 (Sodium Hydroxide Chemical Storage Building)

.2 Steel coating:

Apply to floor steel at EL 100 000 (Main floor level) above containment pit area for both Building 101 (Ferric Chloride Chemical Storage Building) and Building 102 (Sodium Hydroxide Chemical Storage Building)

3.3 PROTECTION

.1 Allow drying and curing time and protect finished product as per manufacturers instructions.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 03 30 00 - Cast-In-Place Concrete

.2 04 22 00 - Concrete Unit Masonry

.3 05 21 00 - Steel Joist Framing

.4 05 31 00 - Steel Decking

.5 05 50 00 - Metal Fabrications

.6 09 91 12 - Specialty Chemical-Resistant Painting

1.2 WORK INCLUDED

.1 Prepare surfaces which are to receive finish. Surfaces include steel not covered under 09 91 12 Speciality Chemical-Resistant Painting, underside steel deck, OWSJ and Concrete Unit Masonry.

.2 Finish surfaces as indicated in the schedule at the end of this Section.

1.3 REFERENCE STANDARDS

.1 Environmental Protection Agency (EPA)

.1 Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, EPA Method 24 - Surface Coatings.

.2 SW-846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Safety Data Sheets (SDS).

.3 Master Painters Institute (MPI)

.1 The Master Painters Institute (MPI)/Architectural Painting Specification Manual (ASM) - [current edition].

.2 Standard GPS-1-12, MPI Green Performance Standard.

.3 Standard GPS-2-12, MPI Green Performance Standard.

.4 National Research Council Canada (NRC)

.1 National Fire Code of Canada 2015 (NFC).

.5 Society for Protective Coatings (SSPC)

.1 SSPC Painting Manual, Volume Two, 8th Edition, Systems and Specifications Manual.

1.4 QUALITY ASSURANCE

.1 Acceptable Manufacturers, materials, workmanship and all items affecting the Work of this Section are to be in accordance with CPCA Architectural Painting Specification Manual.

.2 Prior to ordering paints, submit to the Contract Administrator for review a complete schedule of paint materials proposed for use. This schedule shall include Manufacturer's name, brand name or code number, type and recommended application.

1.5 COLOUR SCHEDULE

.1 Paint colours shall be as per room finish schedule and as selected by the Contract Administrator.

.2 Prior to commencement of Work, the Contract Administrator will furnish three (3) copies of colour schedule.

1.6 DELIVERY

.1 Deliver paint materials in sealed original labelled containers, bearing Manufacturer's name, type of paint, brand name, colour designation and instructions for mixing or reducing.

1.7 STORAGE

.1 Provide adequate storage facilities. Store paint materials at a minimum ambient temperature of 8°C and in a well-ventilated area.

.2 Take all precautionary measures to prevent fire hazards and spontaneous combustion.

1.8 ENVIRONMENTAL CONDITIONS

.1 Ensure surface temperatures or the surrounding air temperature is above 5°C before applying finishes. Minimum application temperatures for latex paints for interior Work is 7°C and for exterior Work 10°C.

.2 Provide adequate continuous ventilation and sufficient heating facilities to maintain temperatures above 7°C for twenty-four (24) hours before, during and forty-eight (48) hours after application of finishes.

.3 Provide minimum 300 Lux of lighting on surfaces to be finished.

1.9 PROTECTION

.1 Adequately protect other surfaces from paint and damage. Make good any damage as a result of inadequate or unsuitable protection.

.2 Furnish sufficient drop cloths, shields and protective equipment to prevent spray or droppings from fouling surfaces not being painted and in particular, surfaces within storage and preparation area.

.3 Place cotton waste, cloths and material which may constitute a fire hazard in closed metal containers and remove daily from Site.

.4 Remove all electrical plates, surface hardware, fittings and fastenings, prior to painting operations. These items are to be carefully stored, cleaned and replaced on completion of Work in each area. Do not use solvents that may remove the permanent lacquer finish to clean hardware.

1.10 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's instructions, printed product literature and data sheets for paint and paint products and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit 2 copies of WHMIS SDS in accordance with Section 01 35 29.06 - Health and Safety Requirements and 01 35 43 - Environmental Procedure.

.3 Confirm products to be used are in MPI's approved product list.

.3 Upon completion, provide records of products used. List products in relation to finish system and include the following:

.1 Product name, type and use.

.2 Manufacturer's product number.

.3 Colour number[s].

.4 MPI Environmentally Friendly classification system rating.

.5 Manufacturer's Safety Data Sheets (SDS).

.6 MPI #

.4 Samples:

.1 Submit full range colour sample chips to indicate where colour availability is restricted.

.2 Prepare 300 mm x 200 mm samples of paint type finishes when requested by Contract Administrator. Apply finishes on identical type materials to which they will be applied on job.

.3 Identify each sample as to finish, colour name and number and sheen name and gloss units.

.5 Test reports: Provide certified test reports for paint from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

.1 Lead, cadmium and chromium: presence of and amounts.

.2 Mercury: presence of and amounts.

.3 Organochlorines and PCBs: presence of and amounts.

.6 Certificates: Provide certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties. MPI Gateway #.

.7 Manufacturer's Instructions:

.1 Provide manufacturer's installation and application instructions.

1.11 CLOSEOUT SUBMITTALS

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

.2 Operation and Maintenance Data: Provide operation and maintenance data for painting materials for incorporation into manual.

.3 Include:

.1 Product name, type and use.

.2 Manufacturer's product number.

.3 Colour number[s].

.4 MPI Environmentally Friendly classification system rating.

1.12 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Stock Materials:

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

Part 2 Products

2.1 MATERIALS

.1 Paint materials to be Products of a single Manufacturer.

.2 All painting materials shall be the best quality and shall be accepted by the Contract Administrator.

.3 Paint shall not be settled, caked or thickened in the container, shall be readily dispersed with a paddle to a smooth consistency, and shall have excellent application properties.

.4 Paint shall arrive on the job colour-mixed except for tinting of undercoats and possible thinning.

.5 All thinning and tinting materials shall be as recommended by the Manufacturer for the particular material thinned or tinted.

.6 Mixed colours shall match colour selection made by the Contract Administrator prior to application of the coating.

.7 Paint shall be ready mixed except field catalyzed coatings. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating.

.8 Paint shall have good flow and brushing properties, and be capable of drying or curing free of streaks or sags.

.9 Paint accessory materials: Linseed oil, shellac, turpentine, and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality.

.10 Paint Acceptable Manufacturers: Pratt & Lambert, Benjamin Moore, C.I.L., or approved equal in accordance with B8.

.11 Specialty Coatings Acceptable Manufacturer shall be ARC FR system or approved equal in accordance with B8.

Part 3 Execution

3.1 CONDITIONS OF SURFACES

.1 Thoroughly examine all surfaces schedule to be painted prior to commencement of Work. Report in writing to the Contract Administrator any condition that may potentially affect proper application. Do not commence until all such defects have been corrected.

.2 Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below maximums established by the paint Manufacturer.

.3 Beginning of installation means acceptance of existing surfaces.

3.2 PREPARATION OF SURFACES

.1 Impervious Surfaces: remove mildew by scrubbing with a solution of TSP and bleach. Rinse with clean water and allow surface to dry completely.

.2 Insulated Surfaces: remove dirt, grease and oil from canvas and cotton insulated coverings.

.3 Aluminum Surfaces scheduled for Paint Finish: remove contamination by steam, high pressure water or solvent washing. Remove acid etch and solvent washing. Apply etching primer immediately following cleaning.

.4 Galvanized surfaces: remove surface contamination and oils from surfaces and wash with solvent. Apply a coat of etching type primer.

.5 Zinc coated surfaces: remove surface contamination and oils from surfaces and prepare for priming in accordance with metal Manufacturer’s recommendations.

.6 Remove stains caused by weathering of corroding metals from concrete with a solution of sodium metasilicate after being thoroughly wetted with water. Allow to thoroughly dry.

.7 Steel and iron surfaces: remove grease, rust, scale, dirt and dust from surfaces. Where heavy coatings of scale are evident, remove by wire brushing, sandblasting or any other necessary method. Ensure all steel surfaces are satisfactory before paint finishing.

.8 Wood items and millwork: wipe off dust and grit from all miscellaneous wood items and millwork prior to priming. Spot coat knots, pitch streaks and sappy sections with sealer. Fill all nail holes and cracks after primer has dried and sand between coats. Back prime interior and exterior woodwork.

.9 Unprimed steel surfaces: clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts and nuts are similarly cleaned. Prime surfaces to identify defects. Prime paint after defects have been remedied.

.10 Copper surfaces scheduled for a paint finish: Remove contamination by steam, high pressure water, or solvent washing. Apply vinyl etch primer immediately following cleaning.

.11 Concrete and unit masonry surfaces scheduled to receive paint finish: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate, rinse well and allow to dry. Remove stains caused by

weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.

.12 Specialty Coating for UV shall be prepared for according to any additional instructions by Manufacturer.

3.3 APPLICATIONS

.1 Apply paint and other finishes in accordance with good trade practice.

.2 Finishes specified are intended to cover surfaces satisfactorily when applied in accordance with Manufacturer's recommendations.

.3 Apply each coat at the proper consistency.

.4 Each coat of paint is to be slightly darker than the preceding coat unless otherwise acceptable to the Contract Administrator.

.5 Sand lightly between coats to achieve required finish.

.6 Do not apply finishes on surfaces that are not sufficiently dry.

.7 Allow each coat of finish to dry before a following coat is applied, unless directed otherwise by Manufacturer.

3.4 PROCESS, MECHANICAL, AND ELECTRICAL EQUIPMENT

.1 Refer to Process, Mechanical, and Electrical Sections with respect to painting and finishing requirements.

.2 Remove grilles, covers and access panels for mechanical and electrical systems from location and paint separately.

.3 Finish paint primed equipment.

.4 Prime and paint insulated and exposed pipes, conduits, boxes, hangers, brackets, collars and supports to match adjacent Work, except where items are plated or pre-finished unless otherwise noted as being painted as separate colour than surrounding Work - refer to Section 15010.

.5 Replace identification markings on mechanical or electrical equipment when painted over or spattered.

.6 Paint interior surfaces of air ducts, convector and baseboard heating cabinets that are visible through grilles and louvres with one (1) coat of flat black paint to limit of sight line. Paint dampers exposed behind louvres, grilles, convector and baseboard cabinets to match face panels.

.7 Paint exposed conduit and electrical equipment occurring in finished areas including baseboard heaters and force flow heaters. Colour and texture are to be selected by Contract Administrator.

.8 Paint both sides and edges of plywood backboards for electrical equipment before installing backboards and before mounting equipment on them.

.9 Colour coding equipment, piping, conduit and exposed ductwork and all colour banding and identification (flow arrows, naming, numbering, etc.) shall be performed to the requirements of Divisions 11 and 15. Piping and ductwork not required to be coded shall be painted in accordance with Mechanical and Process colour schedules.

.10 Paint all exposed exterior mechanical and electrical equipment that has not been factory finished.

.11 Ductwork and piping in truck bay to be finished with epoxy paint.

3.5 PROTECTION

.1 Protect other surfaces from paint or damage. Repair damage.

.2 Furnish drop cloths, shields, and protective methods to prevent spray or droppings from disfiguring other surfaces.

.3 Collect cotton waste, cloths and material which may constitute a fire hazard, place in closed metal containers and remove daily from Site.

3.6 CLEANING

.1 As Work proceeds and upon completion, promptly remove all paint where spilled, splashed or spattered.

.2 During the progress of Work keep the premises free from any unnecessary accumulation of tools, equipment, surplus materials and debris.

.3 Upon completion of Work leave premises neat and clean, to the satisfaction of the Contract Administrator.

3.7 PAINTING AND FINISHING SCHEDULE

.1 Interior Painting:

- .1 Primed Metal Surfaces:
  - .1 One (1) coat enamel undercoat
  - .2 Two (2) coats alkyd semi-gloss enamel
- .2 Galvanized Metal Surfaces:
  - .1 One (1) coat galvanized iron primer
  - .2 Two (2) coats alkyd semi-gloss
- .3 Concrete Block and Concrete
  - .1 One (1) coat latex block filler
  - .2 Two (2) coats alkyd enamel semi-gloss finish

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Fire extinguishers

.2 Fire extinguisher mounting hardware

1.2 GENERAL REQUIREMENTS

.1 Provide portable hand extinguishers where indicated on drawings.

1.3 REFERENCES

.1 National Research Council (NRC)/Institute for Research in Construction

.1 NFC 2010, National Fire Code of Canada

.2 National Fire Protection Association

.1 NFPA 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities.

.2 NFPA 10, Standard for Portable Fire Extinguishers.

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.

.3 Closeout Submittals:

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

Part 2 Products

2.1 PORTABLE HAND FIRE EXTINGUISHERS

.1 Multi-Purpose Dry Chemical (Type 1): pressurised with hose and shut-off nozzle or integral shut-off nozzle and mounting brackets 4.5 kg capacity rating 4A:60BC; 9.0 kg capacity rating 10A:80BC.

2.2 FIRE EXTINGUISHER CABINETS AND BRACKETS.

.1 Fire Extinguisher Bracket: surface type steel construction. Painted Finish.

Part 3 Execution

3.1 INSTALLATION

.1 Install extinguishers so that the bottom of extinguisher is no more than 1200 mm above finished floor.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

1.2 SUBMITTALS

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

.2 Shop drawings to show:

- .1 Mounting arrangements.
- .2 Operating and maintenance clearances.

.3 Shop drawings and product data accompanied by:

- .1 Detailed drawings of bases, supports, and anchor bolts.
- .2 Acoustical sound power data, where applicable.
- .3 Points of operation on performance curves.
- .4 Manufacturer to certify current model production.
- .5 Certification of compliance to applicable codes.

.4 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

.5 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.
- .3 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.
- .4 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.
- .5 Performance data to include:
  - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
  - .2 Equipment performance verification test results.
  - .3 Special performance data as specified.
  - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.6 Approvals:

.1 Submit 1 copy of draft Operation and Maintenance Manual to Contract Administrator for approval. 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.

.7 Additional data:

.1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.

.8 Site records:

.1 Contract Administrator will provide 1 set of mechanical drawings in PDF format. Provide sets of white prints as required for each phase of Work. Mark changes as Work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.

.2 Transfer information weekly to reproducibles, revising reproducibles to show Work as actually installed.

.3 Use different colour waterproof ink for each service.

.4 Make available for reference purposes and inspection.

.9 As-built drawings:

.1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.

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

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

.4 Perform testing, adjusting and balancing for HVAC using as-built drawings.

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

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

1.3 MAINTENANCE

.1 Furnish spare parts in accordance with Section 01 78 00 - Closeout Submittals as follows:

.1 One set of packing for each pump.

.2 One casing joint gasket for each size pump.

.3 One glass for each gauge glass.

.2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00 - Closeout Submittals.

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

Part 2 Products

2.1 Not used

Part 3 Execution

3.1 PAINTING REPAIRS AND RESTORATION

.1 Prime and touch up marred finished paintwork to match original.

.2 Restore to new condition, finishes which have been damaged.

3.2 CLEANING

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

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic Site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule Site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.4 DEMONSTRATION

.1 Contract Administrator will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

.2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular Work hours, prior to acceptance.

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

.4 Instruction duration time requirements as specified in appropriate sections.

.5 Contract Administrator may record these demonstrations on video tape for future reference.

3.5 PROTECTION

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

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for plumbing pumps.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheet for fixtures and equipment.

.3 Shop Drawings.

.1 Submit shop drawings to indicate:

.1 Equipment, including connections, fittings, control assemblies and ancillaries. Identify whether factory or field assembled.

.2 Wiring and schematic diagrams.

.3 Dimensions and recommended installation.

.4 Pump performance and efficiency curves.

.4 Instructions: submit manufacturer's installation instructions.

.5 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals, include:

.1 Manufacturer’s name, type, model year, capacity, and serial number.

.2 Details of operation, servicing, and maintenance.

.3 Recommended spare parts list with names and addresses.

Part 2 Products

2.1 DOMESTIC HOT WATER RECIRC PUMPS

.1 Performance: Please refer to the equipment schedule.

.2 Type: Close-coupled vertical in-line.

.3 Material of Construction: Low pressure ductile Iron Casing, bronze Impeller with EPDM casing O-ring, braided stainless steel with 316 SS Stub shaft.

.4 Mechanical Seal: stainless steel material of construction with EPDM secondary seal with Sintered Silicon Carbide rotating face and secondary seat.

.5 Surface Finish: E-coated.

.6 Flange Rating: ANSI-125

.7 Connections: 1-1/4” Inlet and Outlet

.8 Maximum allowable pressure of 10.34 bar (150 psi) and maximum operating temperature of 82°C (180°F).

.9 Permanently lubricated ball bearings.

.10 Flow readout: output to BMS.

.11 Electric Motors as per Section 230513 – Common Motor Requirements for HVAC equipment.

.12 Option - Sensorless bundle.

.13 Acceptable product: “Armstrong” model 4380 Series 1205 or approved equivalent in accordance with B8.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Make piping and electrical connections to pump and motor assembly and controls as indicated.

.2 Ensure pump and motor assembly do not support piping.

3.3 FIELD QUALITY CONTROL

.1 Site Tests/Inspection:

.1 Check power supply.

.2 Check starter protective devices.

.2 Start-up, check for proper and safe operation.

.3 Check settings and operation of hand-off-auto selector switch, operating, safety and limit controls, audible and visual alarms, over-temperature and other protective devices.

.4 Adjust flow from water-cooled bearings.

.5 Adjust impeller shaft stuffing boxes, packing glands.

3.4 START-UP

.1 General:

.1 In accordance with Appendix 17.

.2 Procedures:

.1 Check power supply.

.2 Check starter O/L heater sizes.

.3 Start pumps, check impeller rotation.

.4 Check for safe and proper operation.

.5 Check settings, operation of operating, limit, safety controls, over-temperature, audible/visual alarms, other protective devices.

.6 Test operation of hands-on-auto switch.

.7 Test operation of alternator.

.8 Adjust leakage through water-cooled bearings.

.9 Adjust shaft stuffing boxes.

.10 Adjust leakage flow rate from pump shaft stuffing boxes to manufacturer's recommendations.

.11 Check base for free-floating, no obstructions under base.

.12 Run-in pumps for 12 continuous hours.

.13 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.

.14 Adjust alignment of piping and conduit to ensure full flexibility.

.15 Eliminate causes of cavitation, flashing, air entrainment.

.16 Measure pressure drop across strainer when clean and with flow rates as finally set.

.17 Replace seals if pump used to degrease system or if pump used for temporary heat.

.18 Verify lubricating oil levels.

3.5 REPORTS

.1 In accordance with Appendix 17: reports, supplemented as specified.

.2 Include:

.1 PV results on approved PV Report Forms.

.2 Product Information report forms.

.3 Pump performance curves (family of curves) with final point of actual performance.

3.6 TRAINING

.1 In accordance with Appendix 17: Training of O M Personnel, supplemented as specified.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Includes the supply, installation, and commissioning of domestic water piping, fittings, valves and accessories as specified herein.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME)

- .1 ANSI/ASME B16.15, Cast Bronze Threaded Fittings, Classes 125 and 250.
- .2 ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
- .3 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- .4 ANSI/ASME B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500.

.2 ASTM International Inc.

- .1 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .2 ASTM A536, Standard Specification for Ductile Iron Castings.
- .3 ASTM B88M-09, Standard Specification for Seamless Copper Water Tube (Metric).

.3 American National Standards Institute/American Water Works Association (ANSI)/(AWWA)

- .1 ANSI/AWWA C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.4 Canadian Standards Association (CSA International)

- .1 CSA B242, Groove and Shoulder Type Mechanical Pipe Couplings.

.5 Department of Justice Canada (Jus)

- .1 Canadian Environmental Protection Act, c. 33 (CEPA).

.6 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

- .1 Material Safety Data Sheets (MSDS).

.7 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.

.8 National Research Council (NRC)/Institute for Research in Construction

- .1 NRCC 38728, National Plumbing Code of Canada (NPC) - 10.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for insulation and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Closeout Submittals:

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

Part 2 Products

2.1 PIPING

.1 Domestic hot, cold and recirculation systems, within building.

.1 Above ground: copper tube, hard drawn, type L: to ASTM B88M.

2.2 FITTINGS

.1 Bronze pipe flanges and flanged fittings, Class 150: to ANSI/ASME B16.24.

.2 Cast bronze threaded fittings, Class 125 and 250: to ANSI/ASME B16.15.

.3 Cast copper, solder type: to ANSI/ASME B16.18.

.4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.

.5 NPS 2 (50mm) and larger: ANSI/ASME B16.18 or ANSI/ASME B16.22 roll grooved to CSA B242.

.6 NPS 1 ½ (38mm) and smaller : wrought copper to ANSI/ASME B16.22, cast copper to ANSI/ASME B16.18; with 301 stainless steel internal components and EPDM seals. Suitable for operating pressure to 1380 kPa.

2.3 JOINTS

.1 Rubber gaskets, latex-free 1.6 mm thick: to AWWA C111.

.2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.

.3 Solder: tin copper alloy.

.4 Teflon tape: for threaded joints.

.5 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM gasket.

.6 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner.

2.4 SWING CHECK VALVES

.1 NPS 2 (50mm) and under, screwed:

.1 To MSS-SP-80, Class 125, 860 kPa, lead free bronze body, lead free brass plug, screw in bronze cap, PTFE seat, suitable for installation in vertical upflow, NPT ends. Approvals: CSA, NSF 61

.2 Acceptable Product: “Apollo” Series 163T LF or approved equivalent in accordance with B8.

2.5 BALL VALVES

.1 NPS 2 (50mm) and under, screwed:

.1 Class 150.

.2 Lead free brass body, RPTFE seat, stainless steel ball, RPTFE stem packing, corrosion resistant plated steel nut, stainless steel stem, lead free brass retainer, plated steel / insulated polyvinyl handle, brass gland ASTM b16, Approvals: CSA, NSF 61, MSS-SP-110

.3 Acceptable Product: “Apollo” Series 77FLF140 or approved equivalent in accordance with B8.

.2 NPS 2 ½ (63mm) and over, screwed:

.1 Class 150.

.2 Lead free brass body, RPTFE seat, stainless steel ball, RPTFE stem packing, corrosion resistant plated steel nut, stainless steel stem, lead free brass retainer, plated steel / insulated polyvinyl handle, brass gland ASTM b16, Approvals: CSA, NSF 61, MSS-SP-110

.3 Acceptable Product: “Apollo” Series 77FLF140 or approved equivalent in accordance with B8.

2.6 BALANCING VALVE

.1 NPS 2 (50mm) and under, screwed:

.1 Lead-Free Brass body/SS ball construction with glass and carbon filled TFE seat rings. Valves to have differential pressure read-out ports across valve seat area. Read-out ports to be fitted with internal EPT inserts/ check valves. Valve bodies to have 6mm (1/4” NPT) tapped drain/purge port. Valves to have memory stop feature to allow valve to be closed for service and then reopened to set point without disturbing balance position. All valves to have calibrated nameplates to assure specific valve settings. Valves shall be designed for positive shut-off.

.2 Design Pressure/Temperature

.1 2758 kPa at 121°C

.2 Acceptable Product: “Xylem B&G” CB-2 LF or approved equivalent in accordance with B8.

2.7 STRAINER

.1 NPS 2 (50mm) and under, screwed:

.1 Class 125

.2 Lead free cast copper silicon alloy body, lead free copper silicon alloy retainer cap, EPDM O-Ring cap seal, 1.2mm 304 stainless steel perforated screen, Approvals: CSA, NSF 61

.3 Acceptable Product: “Watts” Series LF777 or approved equivalent in accordance with B8.

Part 3 Execution

3.1 APPLICATION

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

3.2 INSTALLATION

.1 Install in accordance with Provincial Plumbing Code and local Authority Having Jurisdiction.

.2 Install pipework 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 so as 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. Minimize use of fittings.

3.3 VALVES

.1 Isolate equipment, fixtures and branches with ball valves.

.2 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings on completion.

3.4 PRESSURE TESTS

.1 Test pressure: greater of 1 times maximum system operating pressure or 860 kPa.

3.5 FLUSHING AND CLEANING

.1 Flush entire system for 8 h. Ensure outlets flushed for 2 hours. Let stand for 24 hours, then draw one sample off longest run. Submit to testing laboratory to verify that system is clean copper to Provincial potable water guidelines. Let system flush for additional 2 hours, then draw off another sample for testing.

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 approval.

3.8 START-UP

.1 Timing: start up after:

.1 Pressure tests have been completed.

.2 Disinfection procedures have been completed.

.3 Certificate of static completion has been issued.

.4 Water treatment systems operational.

.2 Provide continuous supervision during start-up.

.3 Start-up procedures:

.1 Establish circulation and ensure that air is eliminated.

.2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.

.3 Bring HWS storage tank up to design temperature slowly.

.4 Monitor piping HWS and HWC piping systems for freedom of movement, pipe expansion as designed.

.5 Check control, limit, safety devices for normal and safe operation.

.4 Rectify start-up deficiencies.

3.9 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 Verify performance of temperature controls.

.3 Verify compliance with safety and health requirements.

.4 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.

.5 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.

.3 Reports:

.1 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

3.10 OPERATION REQUIREMENTS

.1 Co-ordinate operation and maintenance requirements including, cleaning and maintenance of specified materials and products.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Includes the supply, installation, and commissioning of drainage waste and vent (DWV) piping, fittings, and accessories as specified herein.

1.2 REFERENCES

.1 ASTM International Inc.

.1 ASTM D2235-04, Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.

.2 ASTM D2564-04e1, Standard Specification for Solvent Cements for Poly(Vinyl-Chloride) (PVC) Plastic Piping Systems.

.2 Canadian Standards Association (CSA International)

.1 CAN/CSA-Series B1800-06, Thermoplastic Nonpressure Pipe Compendium - B1800 Series.

.3 Green Seal Environmental Standards (GSES)

.1 Standard GS-36-00, Commercial Adhesives.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.5 South Coast Air Quality Management District (SCAQMD), California State

.1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for piping and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

Part 2 Products

2.1 PIPING AND FITTINGS

.1 Buried and above ground PVC-DWV piping to:

.1 CAN/CSA B1800.

2.2 JOINTS

.1 Solvent weld for PVC: to ASTM D2564.

Part 3 Execution

3.1 APPLICATION

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

3.2 INSTALLATION

.1 In accordance with Section 23 05 05 - Installation of Pipework.

.2 Install in accordance with Manitoba Plumbing Code and 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 as far as the next cleanout, at least.

.2 Test to ensure traps are fully and permanently primed.

.3 Storm water drainage:

- .1 Verify domes are secure.
- .2 Ensure weirs are correctly sized and installed correctly.
- .3 Verify provisions for movement of roof system.

.4 Ensure fixtures are properly anchored, connected to system and effectively vented.

.5 Affix applicable label (storm, sanitary, vent, pump discharge) c/w directional arrows every floor or 4.5 m (whichever is less).

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Supply, installation, and commissioning of the new air compressor to the existing compressed air system.

1.2 REFERENCE STANDARDS

.1 American Society of Mechanical Engineers (ASME)

.1 ASME Boiler and Pressure Vessel Code Section VIII Pressure Vessels.

.1 BPVC-VIII B, BPVC Section VIII - Rules for Construction of Pressure Vessels Division 1.

.2 BPVC-VIII-2 B, BPVC Section VIII - Rules for Construction of Pressure Vessels Division 2 - Alternative Rules.

.3 BPVC-VIII-3 B, BPVC Section VIII - Rules for Construction of Pressure Vessels Division 3 - Alternative Rules High Press Vessels.

.2 ASME B16.5, Pipe Flanges and Flanged Fittings.

.3 ASME B16.11, Forged Fittings, Socket-Welding and Threaded.

.2 ASTM International (ASTM)

.1 ASTM B88 - Standard Specification for Seamless Copper Water Tube.

.2 ASTM B813 – Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube.

.3 CSA Group (CSA)

.1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for domestic water heater, and include product characteristics, performance criteria, physical size, finish, and limitations.

.3 Shop Drawings:

.1 Indicate:

.1 Equipment, including connections, fittings, control assemblies and ancillaries, identifying factory and field assembled.

1.4 CLOSEOUT SUBMITTALS

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

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling, and unloading:

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

Part 2 Products

2.1 GENERAL

.1 Finish: Hi Pro Polyester, Painted or approved equivalent as per B8.

2.2 AIR COMPRESSOR

.1 General: Two stage, air-cooled, reciprocating, tank-mounted, V-belt driven.
.2 Valves: Electric
.3 Motor:
  .1 Type: Open Drip Proof
  .2 Input: 575/3/60
.4 Control:
  .1 1st Duty “ON” at 690 kPa;
  .2 2nd Duty “ON” at 620 kPa;
  .3 1st and 2nd Duty “OFF” at 820 kPa;
  .4 Low Pressure alarm at 550 kPa;
.5 Accessories: belt guard and pressure gauges.
.6 Air intakes: complete with bird screen, replaceable cartridge type intake filter and silencer.
.7 Capacity: 62.22 L/s of free air. 1,200 kPa.
.8 Model: Ingersoll Rand 15TE20-P or approved equivalent as per section B8.

2.3 FILTERS

.1 Pre Filter:
  .1 Model: Ingersoll Rand FA150IG or equivalent as per section B8.
.2 High Efficiency:
  .1 Model: Ingersoll Rand FA150IH or equivalent as per section B8.

2.4 AIR PRESSURE REGULATOR

.1 Gauge range: 0 kpa to 965 kPa.
.2 Model: Ingersoll Rand R37461 or equivalent as per section B8.

2.5 PIPING

.1 Pipe for general service compressed air system shall be drawn temper, Type L seamless copper tube, conforming to ASTM B88, with wrought copper solder joint fittings conforming to ASME B16.22.
.2 Copper unions shall conform to ASME B16.22 or MSS SP 123.
.3 Solder filler metal shall consist of lead-free alloys conforming to ASTM B32 with water flushable flux conforming to ASTM B813.

2.6 BALL VALVES

.1 NPS 3 inches and smaller shall be full port, two-piece ball valve conforming to MSS SP 110. The ball valve shall have a SWP rating of 1034 kPa (150 psig) and a CWP rating of 4138 kPa (600 psig). The body material shall be Bronze ASTM B584, Alloy C844. The ends shall be Threaded.

2.7 DRUM GATE VALVES

.1 NPS 3 inches and smaller shall be full port, two-piece ball valve conforming to MSS SP 110. The ball valve shall have a SWP rating of 1034 kPa (150 psig) and a CWP rating of 4138 kPa (600 psig). The body material shall be Bronze ASTM B584, Alloy C844. The ends shall be Threaded.

2.8 COUPLERS/CONNECTORS

.1 The quick connect coupling assemblies shall have a locking mechanism constructed to permit one-handed feature for quick connection and disconnection of compressed air hose and equipment. Furnish complete keyed indexing noninterchangeable coupling to prevent connection to medical compressed-air pressure outlets.

.2 Automatic shutoff quick couplings shall be straight through brass body with O ring or gasket seal and stainless steel or nickel-plated steel operating parts. The automatic shutoff quick connect coupling shall consist of socket or plug ends with one way valve and with barbed outlet or threaded hose fittings for attaching hose.

.3 Valve less quick couplings shall be straight through brass body with O ring or gasket seal and stainless steel or nickel plated steel operating parts. The valve less quick connect coupling shall consist of socket or plug ends and with barbed outlet or threaded hose fittings for attaching hose.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 COMPRESSOR STATION

.1 Install vibration isolators on housekeeping pad as indicated.

3.3 REFRIGERATED AIR DRYER

.1 Install on three-valve bypass.

.2 Install tee connection after dryer for emergency connection to instrument control air system.

3.4 COMPRESSED AIR LINE FILTER

.1 Install on discharge line from refrigerated air dryer.

3.5 MAIN AIR PRESSURE REGULATORS

.1 Install at air compressor station.

.2 Install additional regulators as indicated.

3.6 COMPRESSED AIR PIPING CONNECTIONS AND INSTALLATION

.1 Install flexible connection

.2 Install shut-off valves at outlets, major branch lines and in locations as indicated.

.3 Install quick-coupler chucks and pressure gauges on drop pipes.

.4 Install unions to permit removal or replacement of equipment.

.5 Install tees in lieu of elbows at changes in direction of piping. Install plug in open ends of tees.

.6 Install compressed air trap and pressure equalizing pipe at moisture collecting points. Drain the pipe to nearest floor drain.

.7 Make branch connections from top of main.

.8 Install compressed air trap at bottom of risers and at low points in mains, piped to nearest drain. Distance between drain points to be 30 m maximum.

.9 Provide drain from refrigerated air dryer.

3.7 CLEANING

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

.1 Leave Work area clean at end of each day.

.2 Upon completion remove surplus materials, rubbish, tools, and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Supply, installation, and commissioning of the domestic water heaters that serve the emergency shower/eyewash stations.

1.2 RELATED SECTIONS:

.1 01 33 00 - Submittal Procedures

.2 01 74 11 - Cleaning.

.3 01 78 00 - Closeout Submittals

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.

.2 CAN/CSA-B149.1, Natural Gas and Propane Installation Code.

.3 CAN/CSA-C309-M90, Performance Requirements for Glass-Lined Storage Tanks for Household Hot Water Service.

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 domestic water heater, and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate:

.1 Equipment, including connections, fittings, control assemblies and ancillaries, identifying factory and field assembled.

1.5 CLOSEOUT SUBMITTALS

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

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

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

.2 Protect finished flooring/walls and other finishes of the main floor reception area during delivery. Any damaged to the floors or other parts of the building shall be corrected at the Contractors expense to the satisfaction of the Contract Administrator.

.3 Removal/and reinstallation of the doors/frames, if required, to facilitate delivery is the responsibility of the Contractor. Site verify door dimensions prior to bidding.

Part 2 Products

2.1 HOT WATER HEATERS

.1 Commercial electrical water heater, baked enamel cabinet, glass coated interior, brass drain valve, rated at 150 psi (1034 kPa) working pressure.

.2 Meets standby loss requirements of NRCan and ASHRAE/IES 90.1.

.3 Performance and Capacity: Please refer to the equipment schedule.

.4 Controls: One temperature control and manual reset high temp cut-off per element.

.5 Valve: ASME rated temperature and pressure relief valve.

.6 Surface Finish: Baked enamel or approved equal as per B8.

.7 Acceptable Product: “AO Smith” model DRE-80-12 or approved equal in accordance with B8.

2.2 HOT WATER STORAGE TANKS

.1 Commercial storage tank for potable water at temperatures up to 180F.

.2 Performance and Capacity: Please refer to the equipment schedule.

.3 Rating:160 psi ASME standard working pressure.

.4 Furnished with threaded openings for thermometer, relief valve, 2” recirculation lines, tankstat, and drain valve.

.5 Construction: High density foam insulation meeting R12.5 of U.S. Department of Energy and ASHRAE/IESNA 90.1, heavy gauge steel jacket with baked enamel finish, glass coated interior, cathodic protection.

.6 Surface Finish: Baked enamel or approved equal as per B8.

.7 Acceptable Product: “AO Smith” model TJV-120A or approved equal in accordance with B8.

Part 3 Execution

3.1 APPLICATION

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

3.2 INSTALLATION

.1 Install in accordance with manufacturer's installation instructions and authority having jurisdiction.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's factory trained, certified technician to start up and commission DHW heaters.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Includes the supply, installation, and commissioning of plumbing specialties and accessories as specified herein.

1.2 REFERENCES

.1 ASTM International

.1 ASTM A126, Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.

.2 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.

.2 American Water Works Association (AWWA)

.1 ANSI/AWWA C700, Standard for Cold Water Meters-Displacement Type, Bronze Main Case.

.2 ANSI/AWWA C701, Standard for Cold Water Meters-Turbine Type for Customer Service.

.3 ANSI/AWWA C702, Standard for Cold Water Meters-Compound Type.

.3 CSA International

.1 CSA-B64 Series, Backflow Preventers and Vacuum Breakers.

.2 CSA B79-08, Commercial and Residential Drains and Cleanouts.

.3 CAN/CSA-B356, Water Pressure Reducing Valves for Domestic Water Supply Systems.

.4 Plumbing and Drainage Institute (PDI)

.1 PDI-G101, Testing and Rating Procedure for Grease Interceptors with Appendix of Installation and Maintenance.

.2 PDI-WH201, Water Hammer Arresters Standard.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedure.

.2 Product Data:

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

.3 Shop Drawings:

.1 Indicate on drawings to indicate materials, finishes, dimensions, construction and assembly details, 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 plumbing specialties and accessories for incorporation into manual.

.1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.

.2 Details of operation, servicing and maintenance.

.3 Recommended spare parts list.

Part 2 Products

2.1 General

.1 Surface Finish: Painted

2.2 CLEANOUTS

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

.2 Access Covers:

.1 Wall Access: face or wall type, polished nickel bronze square cover with flush head securing screws, bevelled edge frame completes with anchoring lugs.

.2 Floor Access: rectangular cast iron body and frame with adjustable secured nickel bronze top and:

.1 Plugs: bolted bronze with neoprene gasket.

.2 Cover for Unfinished Concrete Floors: nickel bronze square, gasket, vandal-proof screws.

.3 Cover for Terrazzo Finish: polished nickel bronze with recessed cover for filling with terrazzo, vandal-proof locking screws.

.4 Cover for Tile and Linoleum Floors: polished nickel bronze with recessed cover for linoleum or tile infill, complete with vandal-proof locking screws.

.5 Cover for Carpeted Floors: polished nickel bronze with deep flange cover for carpet infill, complete with carpet retainer vandal-proof locking screws.

2.3 WATER HAMMER ARRESTORS

.1 Copper construction, piston type: to PDI-WH201 or equivalent in accordance with B8.

2.4 TRAP SEAL PRIMERS

.1 Brass, with integral vacuum breaker, NPS 1/2 solder ends, NPS 1/2 drip line connection.

2.5 HOSE BIBB

.1 Brass, with backflow preventer and vacuum breaker, NPS 1/2, NPS 1/2 drip line connection to Zurn Z1341-BFP or equivalent as per B8.

.2 Accessories:

.1 Hose. Air and Water Service complete with quick disconnect fitting as per Greenline G232 or equivalent as per B8.

.2 Hose Reel. Wall mounted spring driven reel with a minimum of 50 ft hose length, epoxy powder finish. Pressure rating to match the hose as specified in the drawing. To Greenline A5806-OLP or equivalent in accordance with B8.

2.6 ROOF DRAINS

.1 Cast Iron A-48-83 Class 20 Material with epoxy coat finish. Refer to drawings for pipe size.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install in accordance with Provincial Plumbing Code of Canada, and local authority having jurisdiction.

.2 Install in accordance with manufacturer's instructions and as specified.

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 NPS 4.

3.4 WATER HAMMER ARRESTORS

.1 Install on branch supplies to fixtures or group of fixtures.

3.5 BACK FLOW PREVENTERS

.1 Install in accordance with CSA-B64 Series, where indicated and elsewhere as required by code.

3.6 HOSE BIBBS AND SEDIMENT FAUCETS

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

3.7 TRAP SEAL PRIMERS

.1 Install for floor drains and elsewhere, as indicated.

.2 Install on cold water supply to nearest frequently used plumbing fixture, in concealed space, to approval of Contract Administrator.

.3 Install soft copper tubing to floor drain.

3.8 STRAINERS

.1 Install with sufficient room to remove basket for maintenance.

3.9 WATER METERS

.1 Install water meter provided by local water authority.

.2 Install water meter as indicated.

3.10 START-UP

.1 General:

.1 In accordance with Appendix 17.

.2 Timing: start-up only after:

.1 Pressure tests have been completed.

.2 Disinfection procedures have been completed.

.3 Certificate of static completion has been issued.

.4 Water treatment systems operational.

.3 Provide continuous supervision during start-up.

3.11 TESTING AND ADJUSTING

.1 General:

.1 Test and adjust plumbing specialties and accessories in accordance with Section 01 91 13- General Commissioning (Cx) Requirements: General Requirements, supplemented as specified.

.2 Timing:

.1 After start-up deficiencies rectified.

.2 After certificate of completion has been issued by authority having jurisdiction.

.3 Application tolerances:

.1 Pressure at fixtures: +/- 70 kPa.

.2 Flow rate at fixtures: +/- 20%.

.4 Adjustments:

.1 Verify that flow rate and pressure meet design criteria.

.5 Floor drains:

.1 Verify operation of trap seal primer.

.2 Prime, using trap primer. Adjust flow rate to suit Site conditions.

.3 Check operations of flushing features.

.4 Check security, accessibility, removability of strainer.

.5 Clean out baskets.

.6 Vacuum breakers, backflow preventers, backwater valves:

.1 Test tightness, accessibility for O&M of cover and of valve.

.2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.

.3 Verify visibility of discharge from open ports.

.7 Roof drains:

.1 Check location at low points in roof.

.2 Check security, removability of dome.

.3 Adjust weirs to suit actual roof slopes, meet requirements of design.

.4 Clean out sumps.

.5 Verify provisions for movement of roof systems.

.8 Access doors:

.1 Verify size and location relative to items to be accessed.

.9 Cleanouts:

.1 Verify covers are gas-tight, secure, yet readily removable.

.10 Water hammer arrestors:

.1 Verify proper installation of correct type of water hammer arrester.

.11 Wall, ground hydrants:

.1 Verify complete drainage, freeze protection.

.2 Verify operation of vacuum breakers.

.12 Strainers:

.1 Clean out repeatedly until clear.

.2 Verify accessibility of cleanout plug and basket.

.3 Verify that cleanout plug does not leak.

.13 Hose bibbs, sediment faucets:

.1 Verify that flow and pressure meet design criteria.

.2 Check for leaks, replace compression washer if required.

.14 Hydronic system water Make-up Assembly:

.1 Verify flow, pressure, and connection.

.15 Water meters:

.1 Verify location and accessibility.

.2 Test meter reading accuracy.

3.12 CLOSEOUT ACTIVITIES

.1 Commissioning Reports: in accordance with Appendix 17, reports, supplemented as specified.

.2 Training: provide training in accordance with Appendix 17, Training of O&M Personnel, supplemented as specified.

3.13 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by plumbing specialties and accessories installation.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Supply, installation, and commissioning of the emergency plumbing fixtures as specified herein.

1.2 REFERENCES

.1 American National Standards Institute (ANSI):

.1 ANSI Z358.1 – American National Standard for Emergency Eyewash and Shower Equipment.

1.3 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 fixtures and equipment.

.2 Indicate dimensions, construction details and materials for specified items.

.3 Manufacturer's data sheets indicating operating characteristics, materials, and finishes.

.4 Include details of electrical and mechanical operating parts.

.5 Provide mounting requirements and rough-in dimensions.

.6 Mark each sheet with product drawing designation.

.3 Shop Drawings:

.1 Submit shop drawings to indicate materials, finishes, method of anchorage, number of anchors, dimensions, construction and assembly details, and accessories.

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

.5 Instructions: submit manufacturer's installation instructions.

.6 Manufacturers' Field Reports: manufacturers' field reports specified.

.7 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals, include:

.1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year, and capacity.

.2 Details of operation, servicing, and maintenance.

.3 Recommended spare parts list.

Part 2 Products

2.1 EMERGENCY HEAT TRACE SHOWER AND EYE/FACE WASH (EW-F5120, EW-5121)

.1 Combination shower and eye/face wash unit with heat trace cable to protect unit from freezing to -50F (-46C). Bottom supply.

.1 Showerhead: 22 GPM flow control, 3.1-inch (78.7 mm) diameter yellow impact-resistant plastic head.

.2 Valves: Chrome plated brass 1 inch NPT shower valve operated by a stainless-steel pull rod with triangular handle. Eye/Face wash with chrome plated brass ½ inch NPT stay open ball valve hand operated by stainless steel push handle.

.3 Eye/Face Wash: 5.1 GPM (19.2 L/min) flow rate, impact resistant ABS plastic sprayhead.

.4 Pipe and Fittings: DN 32mm NPT, galvanized steel with epoxy safety yellow coating.

.5 Bowl: Yellow impact-resistant plastic.

.6 Dust Cover: Yellow transparent plastic.

.7 Pipe and Fittings: 1-1/4-inch galvanized steel pipe. ¾ inch polyethylene vertical semi-slit pipe insulation.

.8 Electric Heat Trace Cable: powered from 120VAC, 5 watts/foot thermal rating.

.9 Water Tempering Valve and Cabinet: Emergency fixture thermostatic mixing valve assembly. Dial thermometer. ASSE 1071 certified. Exceeds ANSI Z358.1. Surface mounted stainless-steel cabinet. Cabinet dimensions (WxHxD): 608x610x165 mm.

.2 Acceptable Product: Eyewash: “Bradley” Model: S19-304GAB, Water Tempering Valve and Cabinet: “Bradley” S19-2100 EFX25 or approved equal as per B8.

2.2 EMERGENCY SHOWER AND EYEWASH (EW-F5220, EW-F5221, EW-F5230, EW-F5321)

.1 Combination drench shower and eyewash with integral strainer.

.1 Eyewash: 5.1 GPM (19.2L) flow control, protected by flip open dust covers that open when activated by 304 stainless steel push handle. Sprayheads made from impact resistant ABS plastic.

.2 Ball Valves: 1 inch shower ball valve, ½ inch stay-open chrome-plated brass stay-open wash valve.

.3 Showerhead: 3.1-inch diameter highly visible yellow-impact resistant plastic. 22 GPM (75.7L) water flow.

.4 Valve Operation: 304 stainless steel pull rod and handle.

.5 Pipe and Fittings: 1-1/4-inch NPT, galvanized steel with epoxy safety yellow coating.

.6 Bowl: Yellow impact resistant plastic.

.7 Water Tempering Valve and Cabinet: Emergency fixture thermostatic mixing valve assembly. Dial thermometer. ASSE 1071 certified. Exceeds ANSI Z358.1. Surface mounted 18-gauge stainless steel cabinet. Cabinet dimensions (WxHxD): 279x316x165 mm.

.2 Acceptable Product: Eyewash: “Bradley” Model: S19314EW, Water Tempering Valve and Cabinet: “Bradley” S19-2150 EFX20 or approved equal as per B8.

2.3 SELF CONTAINED EMERGENCY SHOWER (EW-F5220, EW-F5521, EW-F5522)

.1 Self contained indoor safety shower complete with safety fixture, surrounding walls, drain pan, control panel and water tank mounted on skid. 525 Gallon storage tank for 15-minute flush.

.1 Showerhead: 22 GPM flow rate, 3.1-inch (78.7 mm) diameter yellow impact-resistant plastic head. Activated by a stainless-steel pull rod.

.2 Eye/Face Wash: 5.1 GPM (19.2L) flow control, protected by flip open dust covers. Impact resistant ABS plastic sprayheads.

.3 Tepid Water Delivery System: self contained shower holds 525 gallons of water for a continuous 15min duration flush from shower and eye/face wash. Water filled through top of tank with 1-1/4" NPT connection. 2 kW, 240V heating element and recirculation system to maintain 60-100F tepid flush.

.4 Water Containment: vacuum formed ABS sloped drain pan with 3-inch drain connection covered by yellow fiberglass grate. ½ inch Phenolic walls.

.5 Skid: 12-gauge stainless steel bolted skid assembly.

.6 Signaling system: 120 VAC red light and horn.

.7 Electrical: 208V, 1 Ph, 60 Hz

.8 Pressure booster: Installed on side of skid, powered by control panel.

.9 Dimensions: Overall dimensions 2634x1816x2571mm

.2 Acceptable Product: Shower: "Bradley" Model: S19366 or approved equal as per B8.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Assemble fixtures and associated fittings and trim in accordance with manufacturer's instructions.

.2 Install fixture supports attached to building structure for fixtures requiring supports.

.3 Install fixtures onto waste-fitting seals or flanges and attach to supports or building structure.

.4 Install fixtures level, plumb, and firmly in place in accordance with manufacturer's rough-in drawings.

.5 Install water supply piping to each fixture requiring water supply connection. Provide stop on each supply in readily serviced location. Fasten supply piping to supports or substrate.

.6 Install trap and waste piping to each fixture requiring sanitary system connection.

.7 Install escutcheons at exposed piping penetrations in finished locations and within cabinets.

.8 Seal joints between fixtures and walls, floors, and countertops with mildew-resistant silicone sealant.

3.3 START-UP

.1 General:

.1 In accordance with Appendix 17.

.2 Timing: start-up only after:

.1 Pressure tests have been completed.
.2 Disinfection procedures have been completed.
.3 Certificate of static completion has been issued.
.4 Water treatment systems operational.

.3 Provide continuous supervision during start-up.

3.4 CLEANING AND PROTECTION

.1 Repair or replace defective work, including damaged fixtures and components.

.2 Clean unit surfaces, test fixtures, and leave in ready-to-use condition.

.3 Turn over keys, tools, maintenance instructions, and maintenance stock to Contract Administrator.

.4 Protect units with water-resistant temporary covering. Do not allow temporary use of plumbing fixtures unless approved in writing by Contract Administrator. Remove protection at Substantial Completion and dispose.

3.5 TESTING AND ADJUSTING

.1 General:

.1 In accordance with Appendix 17.

.2 Set field-adjustable temperature set points of temperature-actuated water mixing valves. Adjust set point within allowable temperature range.

.3 Test and adjust installation.

.4 Remove and replace malfunctioning thermostatic mixing valves and retest.

.5 Commissioning Reports:

.1 In accordance with Appendix 17.

.6 Training:

.1 In accordance with Appendix 17.
.2 Demonstrate full compliance with Design Criteria.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

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

.2 Shop drawings; where required, submit drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.

.3 Shop drawings to show:

- .1 Mounting arrangements.
- .2 Operating and maintenance clearances.

.4 Shop drawings and product data accompanied by:

- .1 Detailed drawings of bases, supports, and anchor bolts.
- .2 Acoustical sound power data, where applicable.
- .3 Points of operation on performance curves.
- .4 Manufacturer to certify current model production.
- .5 Certification of compliance to applicable codes.

.5 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.
- .3 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.
- .4 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.
- .5 Performance data to include:
  - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
  - .2 Equipment performance verification test results.
  - .3 Special performance data as specified.
  - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .6 Approvals:
  - .1 Make changes as required and re-submit as directed by Contract Administrator.

.7 Additional data:

.1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.

.8 Site records:

.1 Transfer information weekly to reproducibles, revising reproducibles to show Work as actually installed.

.2 Use different colour waterproof ink for each service.

.3 Make available for reference purposes and inspection.

.9 As-built drawings:

.1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.

.2 As required by Appendix 17.

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

1.2 MAINTENANCE

.1 Furnish spare parts in accordance with Section 01 78 00 - Closeout Submittals as follows:

.1 One set of packing for each pump.

.2 One casing joint gasket for each size pump.

.3 One gasket set for each heat exchanger.

.2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00 - Closeout Submittals.

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

Part 2 Products (Not Used)

Part 3 Execution

3.1 PAINTING REPAIRS AND RESTORATION

.1 Prime and touch up marred finished paintwork to match original.

.2 Restore to new condition, finishes which have been damaged.

3.2 CLEANING

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

3.3 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests in accordance with Appendix 17.

3.4 DEMONSTRATION

.1 Contract Administrator will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

.2 Trial usage to apply to following equipment and systems:

.1 Heating, Ventilation and Air Conditioning (HVAC) Systems.

.3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular Work hours, prior to acceptance.

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

.5 Instruction duration time requirements as specified in appropriate sections.

.6 Contract Administrator may record these demonstrations on video tape for future reference.

3.5 PROTECTION

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

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating.

.2 Canadian Standards Association (CSA International)

.1 CSA B139, Installation Code for Oil Burning Equipment.

.3 Green Seal Environmental Standards (GSES)

.1 Standard GS-11, 2nd Edition, Environmental Standard for Paints and Coatings.

.4 National Fire Code of Canada (NFCC)

.5 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

.1 SCAQMD Rule 1113, Architectural Coatings.

.2 SCAQMD Rule 1168, Adhesive and Sealant Applications.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheets for piping and equipment and include product characteristics, performance criteria, physical size, finish and limitations.

Part 2 Products

2.1 MATERIAL

.1 Paint: zinc-rich to CAN/CGSB-1.181.

.1 Primers, paints and coatings: in accordance with manufacturer's recommendations for surface conditions.

Part 3 Execution

3.1 APPLICATION

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

3.2 CONNECTIONS TO EQUIPMENT

.1 In accordance with manufacturer's instructions unless otherwise indicated.

.2 Use valves and either unions or flanges for isolation, ease of maintenance and assembly.

.3 Use double swing joints when equipment mounted on vibration isolation and when piping is 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 related codes.

.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.

.1 Discharge to be visible.

.4 Drain valves: NPS 3/4 gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

3.5 AIR VENTS

.1 Install automatic air vents to 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 NPS 2 and under: isolating unions or bronze valves.

.4 Over NPS 2: isolating flanges.

3.7 PIPEWORK INSTALLATION

.1 Screwed fittings jointed with Teflon tape.

.2 Protect openings against entry of foreign material.

.3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

.4 Assemble piping using fittings manufactured to ANSI standards.

.5 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.

.1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.

.6 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

.7 Install concealed pipework to minimize furring space, maximize headroom, and conserve space.

.8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.

.9 Install, except where indicated, to permit separate thermal insulation of each pipe.

.10 Group piping wherever possible and as indicated.

.11 Ream pipes, remove scale and other foreign material before assembly.

.12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

.13 Provide for thermal expansion as indicated.

.14 Valves:

.1 Install in accessible locations.

.2 Remove interior parts before soldering.

.3 Install with stems above horizontal position unless indicated.

.4 Valves accessible for maintenance without removing adjacent piping.

.5 Install globe valves in bypass around control valves.

.15 Check Valves:

.1 Install silent check valves on discharge of pumps.

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.

.6 Sealing:

.1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.

.2 Elsewhere:

.1 Provide space for firestopping.

.2 Maintain fire rating integrity.

.3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.

.4 Ensure no contact between copper pipe or tube and sleeve.

3.9 ESCUTCHEONS

.1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.

.2 Construction: one-piece type with set screws.

.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 FIRE STOPPING

.1 Install firestopping within annular space between pipes, ducts, insulation and adjacent fire separation.

.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 fires topping material or installation.

.4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

3.11 FLUSHING OUT OF PIPING SYSTEMS

.1 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 11 - Cleaning supplemented as specified in relevant mechanical sections.

.2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.12 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

.1 Advise Contract Administrator 48 hours minimum prior to performance of pressure tests.

.2 Pipework: test as specified in relevant sections of heating, ventilating and air conditioning Work.

.3 Maintain specified test pressure without loss for 4 hours minimum unless specified for a longer period of time in relevant mechanical sections.

.4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.

.5 Conduct tests in presence of Contract Administrator.

.6 Pay costs for repairs or replacement, retesting, and making good. Contract Administrator to determine whether repair or replacement is appropriate.

.7 Insulate or conceal Work only after approval and certification of tests by Contract Administrator.

3.13 EXISTING SYSTEMS

.1 Connect into existing piping systems as indicated.

.2 Be responsible for damage to existing equipment by this Work.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Electrical motors, drives and guards for mechanical equipment and systems.

.2 Supplier and installer responsibility indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.

.3 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 23. Refer to Division 26 for quality of materials and workmanship.

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

.1 ASHRAE 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).

.2 Canadian Standards Association (CSA)

.1 CSA C390, Test Methods, Marking Requirements, and Energy Efficiency Levels for Three-Phase Induction Motors.

.3 Electrical Equipment Manufacturers' Association Council (EEMAC)

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.3 Closeout Submittals

.1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

.1 Regulatory Requirements: Work to be performed in compliance with CEPA, CEAA, TDGA, and applicable Provincial regulations.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

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

Part 2 Products

2.1 GENERAL

.1 Motors: high efficiency, in accordance with local Hydro company standards and to ASHRAE 90.1 and CSA C390

2.2 MOTORS

.1 Provide motors for mechanical equipment as specified.

.2 Motors under 373 W (1/2 HP): speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.

.3 Motors 373 W (1/2 HP) and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees C, 3 phase, 208 V, unless otherwise indicated.

2.3 TEMPORARY MOTORS

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

2.4 BELT DRIVES

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

.2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.

.3 For motors under 7.5 kW (10 HP): standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.

.4 Correct size of sheave determined during commissioning.

.5 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.

.6 Motor slide rail adjustment plates to allow for centre line adjustment.

.7 Supply one set of spare belts for each set installed in accordance with Section 01 78 00 - Closeout Submittals.

2.5 DRIVE GUARDS

.1 Provide guards for unprotected drives.

.2 Guards for belt drives;

- .1 Expanded metal screen welded to steel frame.
- .2 Minimum 1.2 mm thick sheet metal tops and bottoms.
- .3 38 mm dia. holes on both shaft centres for insertion of tachometer.
- .4 Removable for servicing.

.3 Provide means to permit lubrication and use of test instruments with guards in place.

.4 Install belt guards to allow movement of motors for adjusting belt tension.

.5 Guard for flexible coupling:

- .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
- .2 Securely fasten in place.
- .3 Removable for servicing.

.6 Unprotected fan inlets or outlets:

.1 Wire or expanded metal screen, galvanized, 19 mm mesh.

.2 Net free area of guard: not less than 80% of fan openings.

.3 Securely fasten in place.

.4 Removable for servicing.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Fasten securely in place.

.2 Make removable for servicing, easily returned into, and positively in position.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.4 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

Part 1 General

1.1 SUMMARY

.1 Supply, installation and commissioning of the thermometers, pressure gauges, and accessories as specified herein.

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.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-14.4-M88, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.

.2 CAN/CGSB-14.5-M88, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.

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 thermometers and pressure gauges and include product characteristics, performance criteria, physical size, finish and limitations.

Part 2 Products

2.1 GENERAL

.1 Design point to be at mid-point of scale or range.

.2 Ranges: 0-1100 kPa.

2.2 DIRECT READING THERMOMETERS

.1 Industrial, variable angle type, liquid filled, 125 mm scale length: to CAN/CGSB-14.4.

.1 Resistance to shock and vibration.

2.3 THERMOMETER WELLS

.1 Copper pipe: copper or bronze.

.2 Steel pipe: brass or stainless steel.

2.4 PRESSURE GAUGES

.1 Dial type: to ASME B40.100, Grade 2A, liquid filled, stainless steel bourdon tube having 0.5% accuracy full scale unless otherwise specified. Sizes: 75mm, 100mm.

.2 Provide:

.1 Snubber for pulsating operation.

.2 Diaphragm assembly for corrosive service.

.3 Gasketed pressure relief back with solid front.

.4 Bronze stop cock.

Part 3 Execution

3.1 GENERAL

.1 Install thermometers and gauges so they can be easily read from floor or platform.

.1 If this cannot be accomplished, install remote reading units.

.2 Install between equipment and first fitting or valve.

3.2 THERMOMETERS

.1 Install in wells on piping. Include heat conductive material inside well.

.2 Install in locations as indicated and on inlet and outlet of:

.1 Heating Coils.

.2 DHW tanks.

.3 Control valves.

.3 Install wells for balancing purposes.

.4 Use extensions where thermometers are installed through insulation.

3.3 PRESSURE GAUGES

.1 Install in locations as follows:

.1 Suction and discharge of pumps.

.2 Upstream and downstream of PRV's.

.3 Inlet and outlet of liquid side of heat exchangers.

.4 Outlet of boilers.

.5 In other locations as indicated.

.2 Install gauge cocks for balancing purposes, elsewhere as indicated.

.3 Use extensions where pressure gauges are installed through insulation.

3.4 NAMEPLATES

.1 Install engraved Lamicoid nameplates in accordance with Section 23 05 53.01 - Mechanical Identification, identifying medium.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section includes the supply and installation of hangers and supports for piping and equipment as specified herein.

1.2 RELATED SECTIONS

.1 01 33 00 - Submittal Procedures

.2 01 78 00 - Closeout Submittals.

.3 Mechanical drawings.

1.3 REFERENCES

.1 ASTM International

.1 ASTM A125, Standard Specification for Steel Springs, Helical, Heat Treated.

.2 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.3 ASTM A563-07a, Standard Specification for Carbon and Alloy Steel Nuts.

.2 Factory Mutual (FM)

.3 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)

.1 MSS SP58, Pipe Hangers and Supports - Materials, Design and Manufacture.

.2 MSS SP69, Pipe Hangers and Supports - Selection and Application.

.3 MSS SP89, Pipe Hangers and Supports - Fabrication and Installation Practices.

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 data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit shop drawings for:

.1 Bases, hangers and supports.

.2 Connections to equipment and structure.

.3 Structural assemblies.

.3 Certificates:

.1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Manufacturers' Instructions:

.1 Provide manufacturer's installation instructions.

1.5 CLOSEOUT SUBMITTALS

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

1.6 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements:

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

Part 2 Products

2.1 SYSTEM DESCRIPTION

.1 Design Requirements:

.1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.

.2 Base maximum load ratings on allowable stresses prescribed by MSS SP58.

.3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.

.4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.

.5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.

2.2 GENERAL

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

.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.3 PIPE HANGERS

.1 Finishes:

.1 Pipe hangers and supports: galvanized after manufacture.

.2 Use hot dipped galvanizing process then cover with paint.

.3 Ensure steel hangers in contact with copper piping are copper plated.

.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: 13 mm FM approved.

.2 Cold piping NPS 2-1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed to MSS-SP58 and MSS-SP69.

.3 Upper attachment structural: suspension from upper flange of I-Beam:

.1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed to MSS SP69.

.2 Cold piping NPS 2-1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed.

.4 Upper attachment to concrete:

.1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.

.2 Concrete inserts: wedge shaped body with knockout protector plate UL listed to MSS SP69.

.5 Hanger rods: threaded rod material to MSS SP58:

.1 Ensure that hanger rods are subject to tensile loading only.

.2 Provide linkages where lateral or axial movement of pipework is anticipated.

.6 Pipe attachments: material to MSS SP58:

.1 Attachments for steel piping: carbon steel.

.2 Attachments for copper piping: copper plated black steel.

.3 Use insulation shields for hot pipework.

.4 Oversize pipe hangers and supports.

.7 Adjustable clevis: material to MSS SP69 UL listed, 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 SP69.

.9 U-bolts: carbon steel to MSS SP69 with two nuts at each end to ASTM A563.

.1 Finishes for steel pipework: black.

.2 Finishes for copper, glass, brass or aluminum pipework: galvanized, with formed portion plastic coated.

.10 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

2.4 RISER CLAMPS

.1 Steel or cast iron pipe: black carbon steel to MSS SP58, type 42, UL listed.

.2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.

.3 Bolts: to ASTM A307.

.4 Nuts: to ASTM A563.

2.5 INSULATION PROTECTION SHIELDS

.1 Insulated cold piping:

.1 164 kg/m^3 density insulation plus insulation protection shield to: MSS SP69, 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 300 and over, carbon steel to comply with MSS SP69.

2.6 CONSTANT SUPPORT SPRING HANGERS

.1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR).

.2 Load adjustability: 10% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.

.3 Provide upper and lower factory set travel stops.

.4 Provide load adjustment scale for field adjustments.

.5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.

.6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.7 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 springs in series in single casing.

.3 Variable spring hanger complete with factory calibrated travel stops.

.4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.8 EQUIPMENT SUPPORTS

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

2.9 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

2.10 HOUSE-KEEPING PADS

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

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install in accordance with:

.1 Manufacturer's instructions and recommendations.

.2 Vibration Control Devices:

.1 Install on piping systems at pumps, boilers, chillers, cooling towers, and as indicated.

.3 Clamps on riser piping:

.1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
.2 Bolt-tightening torques to industry standards.
.3 Steel pipes: install below coupling or shear lugs welded to pipe.
.4 Cast iron pipes: install below joint.

.4 Clevis plates:

.1 Attach to concrete with 4 minimum concrete inserts, one at each corner.

.5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

.6 Use approved constant support type hangers where:

.1 Vertical movement of pipework is 13 mm or more,
.2 Transfer of load to adjacent hangers or connected equipment is not permitted.

.7 Use variable support spring hangers where:

.1 Transfer of load to adjacent piping or to connected equipment is not critical.
.2 Variation in supporting effect does not exceed 25 % of total load.

3.3 HANGER SPACING

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

.2 Copper piping: up to NPS 1/2: every 1.5 m.

.3 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.

.4 Within 300 mm of each elbow.

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 32	2.4 m	1.8 m
38	3.0 m	2.4 m
50	3.0 m	2.4 m
63	3.7 m	3.0 m
75	3.7 m	3.0 m
89	3.7 m	3.3 m
100	3.7 m	3.6 m
125	4.3 m	
150	4.3 m	
200	4.3 m	
250	4.9 m	

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
300	4.9 m	

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

3.4 HANGER INSTALLATION

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

.2 Adjust hangers to equalize load.

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

3.5 HORIZONTAL MOVEMENT

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

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

3.6 FINAL ADJUSTMENT

.1 Adjust hangers and supports:
- .1 Ensure that rod is vertical under operating conditions.
- .2 Equalize loads.

.2 Adjustable clevis:
- .1 Tighten hanger load nut securely to ensure proper hanger performance.
- .2 Tighten upper nut after adjustment.

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

.4 Beam clamps:
- .1 Hammer jaw firmly against underside of beam.

3.7 CLEANING

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

- .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and requirements for the identification of new equipment, piping systems, ductwork, valves and controllers, including the installation and location of identification systems.

.2 Related Sections:

.1 01 33 00 - Submittal Procedures

.2 01 74 11 - Cleaning.

.3 Appendix R -City of Winnipeg Paint Colour Standard

1.2 REFERENCES

.1 Canadian Gas Association (CGA)

.1 CSA/CGA B149.1, Natural Gas and Propane Installation Code.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.60, Interior Alkyd Gloss Enamel.

.2 CAN/CGSB-24.3, Identification of Piping Systems.

.3 National Fire Protection Association (NFPA)

.1 NFPA 13, Standard for the Installation of Sprinkler Systems.

.2 NFPA 14, Standard for the Installation of Standpipe and Hose Systems.

1.3 SUBMITTALS

.1 Product Data:

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

.3 Product data to include paint colour chips, other products specified in this section.

.4 Samples:

.1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.

.2 Samples to include nameplates, labels, tags, lists of proposed legends.

1.4 QUALITY ASSURANCE

.1 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

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

Part 2 Products

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

.1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.

.2 Lettering and numbers raised or recessed.

.3 Information to include, as appropriate:

.1 Equipment: manufacturer's name, model, size, serial number, capacity.

.2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

.1 Colours:

.1 Hazardous: red letters, white background.

.2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).

.2 Construction:

.1 3 mm thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:

.1 Conform to following table:

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

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

.4 Locations:

.1 Terminal cabinets, control panels: use size # 5.

.2 Equipment in Mechanical Rooms: use size # 9.

2.3 EXISTING IDENTIFICATION SYSTEMS

.1 City of Winnipeg Paint Colour Standard (See Appendix R)

2.4 PIPING SYSTEMS GOVERNED BY CODES

.1 Identification:

.1 Natural gas: to CSA/CGA B149.1.

.2 Propane gas: to CSA/CGA B149.1.

.3 Sprinklers: to NFPA 13.

.4 Standpipe and hose systems: to NFPA 14.

2.5 IDENTIFICATION OF PIPING SYSTEMS

.1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.

.2 Pictograms:

.1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.

.3 Legend:

.1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.

.4 Arrows showing direction of flow:

.1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.

.2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.

.3 Use double-headed arrows where flow is reversible.

.5 Extent of background colour marking:

.1 To full circumference of pipe or insulation.

.2 Length to accommodate pictogram, full length of legend and arrows.

.6 Materials for background colour marking, legend, arrows:

.1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.

.2 Other pipes: pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 °C and intermittent temperature of 200 °C.

.7 Colours and Legends:

.1 Where not listed, obtain direction from Contract Administrator.

.2 Colours for legends, arrows: to following table:

Background colour:	**Legend, arrows:**
Lighter colours	BLACK
Dark colours	WHITE

.3 Background colour marking and legends for piping systems: Refer to Appendix R – City of Winnipeg Paint Colour Standard

2.6 IDENTIFICATION DUCTWORK SYSTEMS

.1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.

.2 Colours: back, or co-ordinated with base colour to ensure strong contrast.

2.7 VALVES, CONTROLLERS

.1 Brass tags with 12 mm stamped identification data filled with black paint.

.2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.8 CONTROLS COMPONENTS IDENTIFICATION

.1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.

.2 Inscriptions to include function and (where appropriate) fail-safe position.

2.9 EQUIPMENT

.1 Identify all equipment with specified tags as indicated on drawings.

2.10 LANGUAGE

.1 Identification in English.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Perform Work in accordance with CAN/CGSB-24.3 except as specified otherwise.

.2 Provide ULC or CSA registration plates as required by respective agency.

3.3 NAMEPLATES

.1 Locations:

.1 In conspicuous location to facilitate easy reading and identification from operating floor.

.2 Standoffs:

.1 Provide for nameplates on hot and/or insulated surfaces.

.3 Protection:

.1 Do not paint, insulate or cover.

3.4 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

.1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.

.2 Adjacent to each change in direction.

.3 At least once in each small room through which piping or ductwork passes.

.4 On both sides of visual obstruction or where run is difficult to follow.

.5 On both sides of separations such as walls, floors, partitions.

.6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.

.7 At beginning and end points of each run and at each piece of equipment in run.

.8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.

.9 Identification easily and accurately readable from usual operating areas and from access points.

.1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.5 VALVES, CONTROLLERS

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

.2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Contract Administrator. Provide one copy (reduced in size if required) in each operating and maintenance manual.

.3 Number valves in each system consecutively.

3.6 CLEANING

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

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.

.2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other Work as specified in this section.

1.2 SCOPE OF WORK

.1 TAB of new air and hydronic systems.

.2 Coordinate Work with all other applicable sections.

1.3 QUALIFICATIONS OF TAB PERSONNEL

.1 Submit names of personnel to perform TAB to Contract Administrator within 90 days of award of contract.

.2 Provide documentation confirming qualifications, successful experience.

.3 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:

.1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1-2002.

.2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-1998.

.3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing-2002.

.4 Recommendations and suggested practices contained in the TAB Standard: mandatory.

.5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.

.6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.

.7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.

.8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.

.9 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist. Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.4 PURPOSE OF TAB

.1 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

1.5 EXCEPTIONS

.1 TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction.

1.6 CO-ORDINATION

.1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.

.2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.7 PRE-TAB REVIEW

.1 Review contract documents before project construction is started and confirm in writing to Contract Administrator adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.

.2 Review specified standards and report to Contract Administrator in writing proposed procedures which vary from standard.

.3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.8 START-UP

.1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.

.2 Follow special start-up procedures specified elsewhere in Division 23.

1.9 OPERATION OF SYSTEMS DURING TAB

.1 Operate systems for length of time required for TAB and as required by Contract Administrator for verification of TAB reports.

1.10 START OF TAB

.1 Notify Contract Administrator 7 days prior to start of TAB.

.2 Start TAB when building is essentially completed, including:

.3 Installation of ceilings, doors, windows, other construction affecting TAB.

.4 Application of weatherstripping, sealing, and caulking.

.5 Pressure, leakage, other tests specified elsewhere Division 23.

.6 Provisions for TAB installed and operational.

.7 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:

.1 Proper thermal overload protection in place for electrical equipment.

.2 Air systems:

.1 Filters in place, clean.
.2 Duct systems clean.
.3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
.4 Correct fan rotation.
.5 Fire, smoke, volume control dampers installed and open.
.6 Coil fins combed, clean.
.7 Access doors, installed, closed.
.8 Outlets installed; volume control dampers open.

.3 Liquid systems:

.1 Flushed, filled, vented.
.2 Correct pump rotation.
.3 Strainers in place, baskets clean.
.4 Isolating and balancing valves installed, open.
.5 Calibrated balancing valves installed, at factory settings.
.6 Chemical treatment systems complete, operational.

1.11 APPLICATION TOLERANCES

.1 Do TAB to following tolerances of design values:

.1 HVAC systems: plus 5 %, minus 5%.
.2 Hydronic systems: plus, or minus 10 %.

1.12 ACCURACY TOLERANCES

.1 Measured values accurate to within plus or minus 2% of actual values.

1.13 INSTRUMENTS

.1 Prior to TAB, submit to Contract Administrator list of instruments used together with serial numbers.

.2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

.3 Calibrate within 3 months of TAB. Provide certificate of calibration to Contract Administrator.

1.14 SUBMITTALS

.1 Submit, prior to commencement of TAB:

.2 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.15 PRELIMINARY TAB REPORT

.1 Submit for checking and approval of Contract Administrator, prior to submission of formal TAB report, sample of rough TAB sheets. Include:

.1 Details of instruments used.
.2 Details of TAB procedures employed.
.3 Calculations procedures.
.4 Summaries.

1.16 TAB REPORT

.1 Format in accordance with referenced standard.

.2 TAB report to show results in SI units and to include:

.1 Project record drawings.

.2 System schematics.

.3 Submit one copies of TAB Report to Contract Administrator for verification and approval, in English in electronic (PDF) format.

1.17 VERIFICATION

.1 Reported results subject to verification by Contract Administrator.

.2 Provide personnel and instrumentation to verify up to 30% of reported results.

.3 Number and location of verified results as directed by Contract Administrator.

.4 Pay costs to repeat TAB as required to satisfaction of Contract Administrator.

1.18 SETTINGS

.1 After TAB is completed to satisfaction of Contract Administrator, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.

.2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.19 COMPLETION OF TAB

.1 TAB considered complete when final TAB Report received and approved by Contract Administrator.

1.20 AIR SYSTEMS

.1 Standard: TAB to most stringent of TAB standards of AABC.

Do TAB of systems, equipment, components, controls specified Division 23.

.2 Qualifications: personnel performing TAB current member in good standing of AABC.

.3 Quality assurance: perform TAB under direction of supervisor qualified by AABC.

.4 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.

.5 Locations of equipment measurements: to include as appropriate:

.1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.

.2 At controllers, controlled device.

.6 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.21 OTHER TAB REQUIREMENTS

.1 General requirements applicable to Work specified this paragraph:

.1 Qualifications of TAB personnel: as for air systems specified this section.

.2 Quality assurance: as for air systems specified this section.

.2 Smoke management systems:

.1 Test for proper operation of all smoke and fire dampers, sensors, detectors installed as component parts of air systems specified Division 23.

Part 2 Products

2.1 NOT USED

.1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 01 33 00 - Submittal Procedures

.2 01 74 11 – Cleaning

.3 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

1.2 REFERENCES

.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 Reference Standards:

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE/IESNA 90.1-10, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 ASTM International Inc.

.1 ASTM B209M-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

.2 ASTM C335-05ae1, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.

.3 ASTM C411-05, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C547-07e1, Standard Specification for Mineral Fiber Pipe Insulation.

.6 ASTM C553-02e1, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

.7 ASTM C612-04e1, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

.8 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.9 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.4 Green Seal Environmental Standards (GSES)

.1 Standard GS-36-00, Commercial Adhesives.

.5 South Coast Air Quality Management District (SCAQMD), California State

.1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

.6 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).

.7 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102-10, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finish and limitations.

.1 Description of equipment giving manufacturer's name, type, model, year and capacity.

.2 Details of operation, servicing and maintenance.

.3 Recommended spare parts list.

.3 Manufacturers' Instructions:

.1 Provide manufacture's written duct insulation jointing recommendations. and special handling criteria, installation sequence, and cleaning procedures.

1.4 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: specialist in performing Work of this section, and have at least 3 years successful experience in this size and type of project.

1.5 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 FIRE AND SMOKE RATING

.1 To CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 INSULATION

.1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24 °C mean temperature when tested in accordance with ASTM C335.

.3 TIAC Code C-1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).

.4 TIAC Code C-2: Mineral fibre blanket to ASTM C553 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 C553.

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to ASTM C553.

2.3 JACKETS

.1 Canvas:

.1 220 gm/m^2 cotton, plain weave, treated with dilute fire-retardant lagging adhesive to ASTM C921.

.2 Lagging adhesive: compatible with insulation.

.3 Aluminum:

.1 To ASTM B209 with moisture barrier as scheduled in PART 3 of this section.

.2 Thickness: 0.81 mm sheet.

.3 Finish: corrugated.

.4 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick stainless steel.

2.4 ACCESSORIES

.1 Vapour retarder lap adhesive:

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

.2 Indoor Vapour Retarder Finish:

.1 Vinyl emulsion type acrylic, compatible with insulation.

.3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.

.4 ULC Listed Canvas Jacket:

.1 220 gm/m^2 cotton, plain weave, treated with dilute fire-retardant lagging adhesive to ASTM C921.

.5 Outdoor Vapour Retarder Mastic:

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: Fibrous glass, untreated 305 g/m^2.

.6 Tape: self-adhesive, aluminum, reinforced, 75 mm wide minimum.

.7 Contact adhesive: quick-setting

.8 Canvas adhesive: washable.

.9 Tie wire: 1.5 mm stainless steel.

.10 Banding: 12 mm wide, 0.5 mm thick stainless steel.

.11 Fasteners: 4 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

Part 3 Execution

3.1 APPLICATION

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

3.2 PRE-INSTALLATION REQUIREMENTS

.1 Pressure test ductwork systems complete, witness and certify.

.2 Ensure surfaces are clean, dry, free from foreign material.

3.3 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturers instructions and as indicated.

.3 Use 2 layers with staggered joints when required nominal thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Ensure hangers, and supports are outside vapour retarder jacket.

.5 Hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

.1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

.6 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum 2 rows each side.

3.4 DUCTWORK INSULATION SCHEDULE

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

	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular and round ducts – outdoor air between intake louver and air handling units	C-1	yes	50
Rectangular and round ducts – exhaust air - between heat recovery coil and/or fan and exhaust louver	C-1	yes	50

.2 Exposed round ducts 600 mm and larger, smaller sizes where subject to abuse:

.1 Use TIAC code C-1 insulation, scored to suit diameter of duct.

.1 Finishes: conform to following table:

	TIAC Code	
	Rectangular	Round
Indoor, exposed	CRF/1	CRD/2
Outdoor, exposed to precipitation	CRF/3	CRD/4

3.5 CLEANING

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

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Insulation of hydronic piping.
.2 Insulation of domestic water piping.
.3 Insulation of roof drains.
.4 Painting and identification.

.2 Related Sections:

.1 01 33 00 - Submittal Procedures
.2 01 74 11 - Cleaning.
.3 230553.01-Identification.
.4 Appendix R_WWD Paint Colour Standard.

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ASHRAE Standard 90.1-10, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM B209M-04, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.
.2 ASTM C335-04, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
.3 ASTM C411-04, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
.4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
.5 ASTM C533-2004, Calcium Silicate Block and Pipe Thermal Insulation.
.6 ASTM C547-2003, Mineral Fiber Pipe Insulation.
.7 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
.8 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
.2 CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketting Sheet, for Insulated Pipes, Vessels and Round Ducts

.4 Department of Justice Canada (Jus)

.1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
.2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
.3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.6 Manufacturer's Trade Associations

.1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).

.7 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S102-10, Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701-11, Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.3 CAN/ULC-S702-09, Thermal Insulation, Mineral Fibre, for Buildings

.4 CAN/ULC-S702.2-03, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.3 DEFINITIONS

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED" - will mean "not concealed" as specified.

.2 TIAC ss:

.1 CRF: Code Rectangular Finish.

.2 CPF: Code Piping Finish.

1.4 SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.3 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.4 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

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

.2 Instructions: submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

.1 Qualifications:

.2 Installer: specialist in performing Work of this Section, and have at least 3 years successful experience in this size and type of project.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:

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

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

.2 Storage and Protection:

.1 Protect from weather, construction traffic.

.2 Protect against damage.

.3 Store at temperatures and conditions required by manufacturer.

Part 2 Products

2.1 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULC-S102.

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.2 INSULATION

.1 Mineral fibre specified includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.

.3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.
.1 Mineral fibre: to CAN/ULC-S702.
.2 Maximum "k" factor: to CAN/ULC-S702.

.4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
.1 Mineral fibre: to CAN/ULC-S702.
.2 Jacket: to CGSB 51-GP-52Ma.
.3 Maximum "k" factor: to CAN/ULC-S702.

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

.6 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: to CAN/ULC-S702.
.4 Certified by manufacturer: free of potential stress corrosion cracking corrodents.

.7 TIAC Code A-2: rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.

.1 Insulation: to ASTM C533.

.2 Maximum "k" factor: to CAN/ULC-S702.

.3 Design to permit periodic removal and re-installation.

2.3 INSULATION SECUREMENT

.1 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.

.2 Contact adhesive: quick setting.

.3 Canvas adhesive: washable.

.4 Tie wire: 1.5 mm diameter stainless steel.

.5 Bands: stainless steel, 19mm wide, 0.5 mm thick.

2.4 CEMENT

.1 Thermal insulating and finishing cement:

.1 Hydraulic setting on mineral wool, to ASTM C449/C449M.

2.5 VAPOUR RETARDER LAP ADHESIVE

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

2.6 INDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.7 OUTDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

.2 Reinforcing fabric: fibrous glass, untreated 305 g/m^2.

2.8 JACKETS

.1 **Indoor**: Polyvinyl Chloride (PVC):

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

.2 Outdoor: Aluminum:

.1 To ASTM B209.
.2 Thickness: 0.50 mm sheet.
.3 Finish: stucco embossed.
.4 Joining: longitudinal and circumferential slip joints with 50mm laps.

.5 Fittings: 0.5mm thick die-shaped fitting covers with factory-attached protective liner.

.6 Metal jacket banding and mechanical seals: stainless steel, 19mm wide, 0.5mm thick at 300mm spacing.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PRE-INSTALLATION REQUIREMENT

.1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.

.2 Surfaces clean, dry, free from foreign material.

3.3 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturers instructions and this specification.

.3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Install hangers, supports outside vapour retarder jacket.

.5 Supports, Hangers:

.1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

.1 Application: at expansion joints, valves, flanges and unions at equipment.

.2 Design: to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.

.3 Insulation:

.1 Insulation, fastenings and finishes: same as system.

.2 Jacket: PVC.

3.5 INSTALLATION OF ELASTOMERIC INSULATION

.1 Insulation to remain dry. Overlaps to manufacturers instructions. Ensure tight joints.

.2 Provide vapour retarder as recommended by manufacturer.

3.6 PIPING INSULATION SCHEDULES

.1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.

.2 Thickness of insulation as listed in following table.

.1 Run-outs to individual units and equipment not exceeding 4000 mm long.

.2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Application	Temp degrees C	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)					
			Run out	to 1	1 1/4 to 2	2 1/2 to 4	5 to 6	8 & 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
Domestic HWS		A-1	25	25	25	38	38	38
Domestic CWS		A-3	25	25	25	25	25	25
Roof drains		A-3	25	25	25	25	25	25

.3 Finishes:

.1 Exposed indoors: canvas jacket.

.2 Exposed in mechanical rooms: canvas.

.3 Concealed, indoors: canvas on valves, fittings. No further finish.

.4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.

.5 Outdoors: water-proof aluminum jacket.

.6 Finish attachments: SS bands, at 150 mm on centre.

.7 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.7 CLEANING

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

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for natural gas piping, valves and fittings for gas fired equipment.

.2 Natural gas piping shall be primed and painted safety yellow per Appendix R - WWD Paint Colour Standard. Identification per Section 23 05 53.01 Mechanical Identification.

1.2 REFERENCE STANDARDS

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B16.5, Pipe Flanges and Flanged Fittings.

.2 ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.

.3 ASME B16.22, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

.4 ASME B18.2.1, Square and Hex Bolts and Screws Inch Series.

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.

.2 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.

.3 ASTM B75M, Standard Specification for Seamless Copper Tube Metric.

.4 ASTM B837, Standard Specification for Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) Gas Fuel Distribution Systems.

.3 Canadian Standards Association (CSA International)

.1 CSA W47.1, Certification of Companies for Fusion Welding of Steel.

.4 Canadian Standards Association (CSA)/Canadian Gas Association (CGA)

.1 CAN/CSA B149.1, Natural Gas and Propane Installation Code Handbook.

.5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.

.2 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

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

.4 Instructions: submit manufacturer's installation instructions.

.5 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 PIPE

.1 Steel pipe: to ASTM A53/A53M, Schedule 40, seamless as follows:

.1 NPS 1/2 to 2, screwed.

.2 NPS2 1/2 and over, plain end.

.2 Copper tube: to ASTM B837.

2.2 JOINTING MATERIAL

.1 Screwed fittings: pulverized lead paste.

.2 Welded fittings: to CSA W47.1.

.3 Flange gaskets: nonmetallic flat.

2.3 FITTINGS

.1 Steel pipe fittings, screwed, flanged or welded:

.1 Malleable iron: screwed, banded, Class 150.

.2 Steel pipe flanges and flanged fittings: to ASME B16.5.

.3 Welding: butt-welding fittings.

.4 Unions: malleable iron, brass to iron, ground seat, to ASTM A47/A47M.

.5 Bolts and nuts: to ASME B18.2.1.

.6 Nipples: schedule 40, to ASTM A53/A53M.

.2 Copper pipe fittings, screwed, flanged or soldered:

.1 Cast copper fittings: to ASME B16.18.

.2 Wrought copper fittings: to ASME B16.22.

2.4 VALVES

.1 Provincial Code approved, lubricated plug type.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PIPING

.1 Install in accordance with Section 23 05 05 - Installation of Pipework, CAN/CSA B149, and applicable Provincial/Territorial Codes, supplemented as specified.

.2 Install drip points:

.1 At low points in piping system.

.2 At connections to equipment.

.3 Prime and paint gas piping safety yellow.

3.3 VALVES

.1 Install valves with stems upright or horizontal unless otherwise approved by Departmental Representative.

.2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.

3.4 FIELD QUALITY CONTROL

.1 Site Tests/Inspection:

.1 Test system in accordance with CAN/CSA B149 and requirements of authorities having jurisdiction.

.2 Manufacturer's Field Services:

.1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, protection and cleaning of its products, and submit written reports, in acceptable format, to verify compliance of work with Contract.

.2 Provide manufacturer's field services, consisting of product use recommendations and periodic site visits for inspection of product installation, in accordance with manufacturer's instructions.

.3 Schedule site visits to review work at stages listed:

.1 Upon completion of work, after cleaning is carried out.

.3 Obtain reports within 3 days of review and submit immediately to Departmental Representative.

.4 PV procedures:

.1 Test performance of components.

3.5 ADJUSTING

.1 Purging: purge after pressure test in accordance with CAN/CSA B149.

.2 Pre-Start-Up Inspections:

.1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.

.2 Check gas trains, entire installation is approved by authority having jurisdiction.

3.6 CLEANING

.1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Materials and installation for steel piping, valves and fittings for hydronic systems.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.
.2 Section 01 78 00 - Closeout Submittals.
.3 Section 23 05 05 - Installation of Pipework.
.4 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
.5

1.3 REFERENCES

.1 American Society of Mechanical Engineers (ASME).

.1 ASME B16.1-98, Cast Iron Pipe Flanges and Flanged Fittings.
.2 ASME B16.3-98, Malleable Iron Threaded Fittings.
.3 ASME B16.5-03, Pipe Flanges and Flanged Fittings.
.4 ASME B16.9-01, Factory-Made Wrought Buttwelding Fittings.
.5 ASME B18.2.1-03, Square and Hex Bolts and Screws (Inch Series).
.6 ASME B18.2.2-87(R1999), Square and Hex Nuts (Inch Series).

.2 American Society for Testing and Materials International, (ASTM).

.1 ASTM A47/A47M-99, Standard Specification for Ferritic Malleable Iron Castings.
.2 ASTM A53/A53M-02, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
.3 ASTM A536-84(1999)e1, Standard Specification for Ductile Iron Castings.
.4 ASTM B61-02, Standard Specification for Steam or Valve Bronze Castings.
.5 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
.6 ASTM E202-00, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.

.3 American Water Works Association (AWWA).

.1 AWWA C111-00, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.4 Canadian Standards Association (CSA International).

.1 CSA B242-M1980(R1998), Groove and Shoulder Type Mechanical Pipe Couplings.
.2 CAN/CSA W48-01, Filler Metals and Allied Materials for Metal Arc Welding (Developed in cooperation with the Canadian Welding Bureau).

.5 Manufacturer's Standardization of the Valve and Fittings Industry (MSS).

.1 MSS-SP-67-025, Butterfly Valves.
.2 MSS-SP-70-98, Cast Iron Gate Valves, Flanged and Threaded Ends.
.3 MSS-SP-71-97, Cast Iron Swing Check Valves Flanged and Threaded Ends.

.4 MSS-SP-80-03, Bronze Gate, Globe, Angle and Check Valves.

.5 MSS-SP-85-02, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.4 SUBMITTALS

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Closeout Submittals.

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

1.5 MAINTENANCE

.1 Extra Materials.

.1 Provide following spare parts:

.1 Valve seats: one for every ten valves, each size. Minimum one.

.2 Discs: one for every ten valves, each size. Minimum one.

.3 Stem packing: one for every ten valves, each size. Minimum one.

.4 Valve handles: two of each size.

.5 Gaskets for flanges: one for every ten flanges.

Part 2 Products

2.1 PIPE

.1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:

.1 To NPS 12: Schedule 40.

2.2 PIPE JOINTS

.1 NPS 2 and under: screwed fittings with Teflon tape.

.2 NPS 2 1/2 and over: welding fittings and flanges to CSAW47.1 and CSA W47.1S1.

.3 Flanges: raised face, weld neck.

.4 Flange gaskets: to ANSI/AWWA C111/A21.11.

.5 Bolts and nuts: to ANSI B18.2.1 and ANSI/ASME B18.2.2.

.6 Pipe thread: taper.

2.3 FITTINGS

.1 Screwed fittings: malleable iron, to ANSI/ASME B16.3, Class 150.

.2 Pipe flanges and flanged fittings:
.1 Steel: to ANSI/ASME B16.5.

.3 Unions: malleable iron, to ASTM A47M and ANSI/ASME B16.3.

.4 Butt - welding fittings: steel, to ANSI/ASME B16.9.

2.4 VALVES

.1 Connections:

.1 NPS 2 and smaller: screwed ends.

.2 NPS 2 ½ and larger: Flanged ends.

.2 Ball Valves:

.1 NPS 2 and under:

.1 To ASTM B62, 4 MPa WOG, bronze body, screwed ends, TFE seal, hard chrome solid ball, Teflon seats and lever handle.

.2 Acceptable product: Toyo Figure 5044A, Crane, Grinnell or approved equivalent in accordance with B8.

.3 Gate valves:

.1 NPS 2 and under:

.1 Rising stem: to MSS SP-80, Class 125, 860 kPa, bronze body, solid wedge disc.

.2 Acceptable material: Toyo Fig 206A, Crane, Grinnell or approved equivalent in accordance with B8.

.2 NPS 2 ½ and over:

.1 Rising stem, OS & Y, bolted bonnet, solid wedge, disc flanged end, to MSS SP-70, cast iron body bronze trim.

.2 Acceptable material: Toyo Fig No. 421A, Crane, Grinnell or approved equivalent in accordance with B8.

.4 Balancing Valves:

.1 NPS 2 and under:

Threaded bronze body construction, brass ball, TFE seat rings c/w memory stop, and differential pressure readout ports.

Acceptable Product: “Bell & Gossett” model CB or approved equivalent in accordance with B8.

.2 NPS 2 ½ and over:

.1 flanged cast iron body construction, c/w memory stop, and differential pressure readout ports.

.3 Acceptable Product: “Armstrong” Model: CBV-FS or approved equivalent in accordance with B8.

.5 Check Valves:

.1 NPS 2 and under, swing type, bronze disc, Class 125:

.1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.

.2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.

.3 Standard specification: MSS SP-80.

.2 NPS 2-1/2 and over, non-slam check valve:

.1 Body: Cast iron incorporated into a triple duty valve

.2 Disc and seat: Brass disc with EPDM seat
.3 Spring and stem: Stainless steel
.4 Include metering ports and drain tapping.
.5 Connection: Flanged
.6 Configuration: Coordinate during shop drawing review.
.7 Size: confirm base on pump design flow rate.
.8 Maximum pump operating pressure of 125#.
.9 Basis of Design: Armstrong FTV or approved in accordance with B8.

.6 Control Valves:

.1 Body: Bronze angle or straight pattern.
.2 Flow up to 862 kPa (125 psig)
.3 Maximum operating temperature of 121°C (250°F)
.4 NPT Connections with bronze vertical lift disc to prevent gravity circulation during normal system “off cycles”. The Valve shall feature a manual open position for gravity circulation.
.5 Acceptable product: Xylem Flo-Control Valves model SA.

Part 3 Execution

3.1 PIPING INSTALLATION

.1 Install pipework in accordance with Section 23 05 05 - Installation of Pipe Work.

3.2 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.

3.3 CLEANING, FLUSHING AND START-UP

.1 Fill system with water, ensure air is vented from system.
.2 Fill expansion tanks 1/3 to 1/2 full, charge system with compressed air to at least 35 kPa (does not apply to diaphragm type expansion tanks).
.3 Use water metre to record volume of water in system to +/- 0.5%.
.4 Add chemicals under direct supervision of chemical treatment supplier.
.5 Closed loop systems: circulate system cleaner at 60 degrees C for at least 36 h. Drain as quickly as possible. Refill with water and inhibitors. Test concentrations and adjust to recommended levels.
.6 Flush velocity in system mains and branches to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.
.7 Add chemical solution to system.
.8 Establish circulation, raise temperature slowly to maximum design. Circulate for 12 h, ensuring flow in all circuits. Remove heat, continue to circulate until temperature is below 38 degrees C. Drain as quickly as possible. Refill with clean

water. Circulate for 6 hours at design temperature. Drain and repeat procedures specified above. Flush through low point drains in system. Refill with clean water adding to sodium sulphite (test for residual sulphite).

3.4 TESTING

.1 For glycol systems, retest with propylene glycol to ASTM E202, inhibited, for use in building system after cleaning. Repair leaking joints, fittings or valves.

3.5 BALANCING

.1 Refer to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

3.6 GLYCOL CHARGING

.1 Provide mixing tank and positive displacement pump for glycol charging.

.2 Retest for concentration to ASTM E202 after cleaning.

3.7 PERFORMANCE VERIFICATION

.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 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 Pump operation.

.2 Boiler and/or chiller operation.

.3 Pressure bypass open/closed.

.4 Control pressure failure.

.5 Maximum heating demand.

.6 Maximum cooling demand.

.7 Boiler and/or chiller failure.

.8 Cooling tower (and/or industrial fluid cooler) fan failure.

.9 Outdoor reset. Re-check heat exchanger output supply temperature at 100% and 50% reset, maximum water temperature.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Includes the supply, delivery, installation, and commissioning of the hydronic specialties as specified herein.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME-04(2007), Boiler and Pressure Vessel Code.

.2 ASTM International Inc.

.1 ASTM A47/A47M-99(2004), Standard Specification for Ferritic Malleable Iron Castings.

.2 ASTM A278/A278M-01(2006), Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (350 degrees C).

.3 ASTM A516/A516M-06, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.

.4 ASTM A536-84(2004), Standard Specification for Ductile Iron Castings.

.5 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.

.3 Canadian Standards Association (CSA International)

.1 CSA B51-03(R2003), Boiler, Pressure Vessel, and Pressure Piping Code.

.2 CSA B51-03(R2005), Boiler, Pressure Vessel, and Pressure Piping Code, Supplement #1.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for expansion tanks, air vents, separators, valves, and strainers and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

.1 Submit maintenance and operation data in accordance with Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 EXPANSION TANK (EXP-1)

.1 Tank volume: 132.5 L (35 gal), acceptance volume: 106 L (28 gal), 406 mm (16 inch) diameter, 1143 mm (45 inch) height.

.2 Pre-charged steel expansion tank, 121°C (250°F) working temperature, stamped with 862 kPa (125 PSI) working pressure. Tank will be supplied with a heavy-duty butyl diaphragm, ring base, lifting rings, and 25mm (1”) NPT system connection. An air

charging valve shall be provided to facilitate adjusting pre-charge pressure to meet actual system conditions. ASME rated.

.3 Acceptable Product: “Armstrong” Model: AX-60V approved equivalent in accordance with B8.

2.2 HYDRONIC SYSTEM FEEDER (HSF-1)

.1 Hydronic system feeder shall include 25 litre (6 USgallon) storage/mixing tank with molded-in liquid level gauge; 100 mm (4”) fill/access opening and cover; pump suction hose with inlet strainer; check valve; pressure pump with fuse protection; low level pump cut-out float switch; manual diverter valve for purging air and agitating contents of storage tank; pressure switch with snubber adjustable from 70 KPa(10 psig) to 170 kPa (25 psig) cut-out pressure ; factory cut-out pressure set to 115 kPa (17 psig); liquid pressure gauge. Unit complete with UL listed power supply adapter with LED power indicator light. Shall be completely pre-assembled and certified by a recognized testing agency to CSA standard C22.2 No 68.

.2 ELECTRICAL: 115/60/1, 50 watts 3-prong plug and cord

.3 PUMP PERFORMANCE: 0.04 l/min (1 gpm) @ free flow Self-priming up to 1.2 m (4 feet) Maximum liquid temp. 77 C (170 F)

.4 ACCESSORIES:

.1 RIA10-1-SAA – Low Level Alarm Panel c/w Remote Monitoring Dry Contacts and Selectable Audible Alarm

.5 Acceptable Product: AXIOM INDUSTRIES LTD. Model MF200 or approved equivalent according to B8.

2.3 AIR VENTS

.1 Automatic air vent suitable for hot water heating system with brass body and high temperature resistant polyethylene float.

.2 Acceptable Product: “Watts” model FV-4M1 or approved equivalent according to B8.

2.4 AIR SEPARATOR, AS-1

.1 50 mm (2”) Threaded inlet and outlet connections, Diameter: 219 mm (8.63”), Height: 400 mm (15.75”), Dry Weight: 32 kg (70 lb), Cast Iron shell.

.2 Coalescing type air eliminator for hot water systems. Rated for 1105 kPa (160 PSI) working pressure, and stamped and registered in accordance with ASME Section VIII, Division 1 for unfired pressure vessels. The elements shall consist of a copper core tube with continuous wound copper wire medium. Separate venting chamber to prevent system contaminants from harming the float actuated brass venting system. Units shall include a valved side tap to flush floating dirt or liquids and for quick bleeding of large amounts of air during system fill or refill.

.3 Acceptable Product: “Armstrong” model VAS-2 or approved equivalent according to B8.

2.5 STRAINER

.1 1/2 NPS to 2 NPS: bronze body to ASTM B62, screwed connections, Y pattern.

.2 2-1/2 NPS to 12 NPS: cast steel body to ASTM A278/A278M, Class 30, flanged connections.

2.6 CHEMICAL POT FEEDER

.1 227.304 L (50 gal) pressure vessel volume. 12 mm (1/2") NPT connections. System shall include carbon steel chemical bypass feeder, and 600 mL polyethylene graduated funnel with integral 20 mesh strainer. 689.47 kPa (100 PSI) maximum pressure.

.2 Acceptable Product: "Neptune" model G-50-1 or approved equivalent in accordance with B8.

2.7 SIDESTREAM FILTER PACKAGE

.1 System shall include filter, sight flow indicator, ball valve, balancing valve, and nipples. Suitable for flow rates from 0-38 L/s (0-10 USGPM).

.2 Filter shall be constructed of 304 stainless steel filter housing with brass head and shall include two EPDM o-rings, brass drain valve with barb fitting and cap, and filter cartridge shall be a cotton wound filter cartridge with stainless steel core (25 micron). Filter housing length shall be 250 mm (10"). 1.5 L (0.4 gal) vessel volume.

.3 Sight flow indicator has brass body and shall include EPDM o-rings, two tempered borosilicate glass windows, 304 stainless steel cage, TPX ball, and cork washers (non-wetted part).

.4 Ball valve shall be of brass construction.

.5 Manual balancing valve shall be of brass construction and comes with an integral air vent, memory stop, and shall be able to provide flow metering, flow balancing, and filter cartridge isolation.

.6 Three brass nipples shall each be 75 mm (3") in length.

.7 19 mm (3/4") FNPT connections. 860 kPa (125 PSI) maximum pressure, 93°C (200°F) maximum temperature. Compatible with water and propylene glycol in concentrations up to 50%.

.8 Acceptable Product: "Axiom" model SFP-10-25M or approved equivalent in accordance with B8.

Part 3 Execution

3.1 APPLICATION

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

3.2 GENERAL

.1 Run drain lines and blow off connections to terminate above nearest drain.

.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 25 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 nearest drain.

3.5 EXPANSION TANKS

.1 Adjust expansion tank pressure to suit design criteria.

.2 Install lockshield type valve at inlet to tank.

3.6 PRESSURE SAFETY RELIEF VALVES

.1 Run discharge pipe to terminate above nearest drain.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Supply, delivery, installation, and commissioning of the hydronic pumps as specified here in.

1.2 REFERENCES

.1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE)

.1 Standard 90.1-2007, Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 Electrical Equipment Manufacturers Advisory Council (EEMAC)

.3 Canadian Standards Association (CSA International)

.1 CSA-B214-07, Installation Code for Hydronic Heating Systems.

.4 National Electrical Manufacturers' Association (NEMA)

.1 NEMA MG 1-2006, Motors and Generators.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for 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.

1.4 CLOSEOUT SUBMITTALS

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

1.5 MAINTENANCE

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

Part 2 Products

2.1 PUMPS (P-F6250)

.1 Acceptable product: Refer to Mechanical Equipment Schedules or approved equal in accordance with B8.

2.2 PUMPS (P-F6350)

.1 Acceptable product: Refer to Mechanical Equipment Schedules or approved equal in accordance with B8.

Part 3 Execution

3.1 APPLICATION

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

3.2 INSTALLATION

.1 Install hydronic pumps to: CSA-B214.

.2 Provide pipe modifications and new flanges as required to match pump. Replace pipe insulation as required.

.3 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.

.4 Base mounted type: supply templates for anchor bolt placement.

.1 Include anchor bolts with sleeves. Place level, shim unit and grout.

.2 Align coupling in accordance with manufacturer's recommended tolerance.

.5 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.

.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 manufacturer's recommendations.

.2 Procedures:

.1 Before starting pump, check that cooling water system over-temperature and other protective devices are installed and operative.

.2 After starting pump, check for proper, safe operation.

.3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.

.4 Check base for free-floating, no obstructions under base.

.5 Run-in pumps for 12 continuous hours minimum.

.6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.

.7 Eliminate air from scroll casing.

.8 Adjust water flow rate through water-cooled bearings.

.9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.

.10 Adjust alignment of piping and conduit to ensure true flexibility.

.11 Eliminate cavitation, flashing and air entrainment.

.12 Adjust pump shaft seals, stuffing boxes, glands.

.13 Measure pressure drop across strainer when clean and with flow rates as finally set.

.14 Replace seals if pump used to degrease system or if pump used for temporary heat.

.15 Verify lubricating oil levels.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 ASTM International

.1 ASTM B209-2021A Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

.2 Green Seal Environmental Standards (GS)

.1 GS-36-11, Standard for Adhesives for Commercial Use.

.3 Sheet Metal Air Conditioning Contractors' National Association (SMACNA)

.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible, 2005.

.2 SMACNA HVAC Air Duct Leakage Test Manual, 2012.

.3 SMACNA IAQ Guideline for Occupied Buildings Under Construction, 2007.

.4 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards

.1 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

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

.3 Test and Evaluation Reports:

.1 Certification of Ratings:

.1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.3 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

.1 Store materials in dry location, off ground, and in accordance with manufacturer's recommendations.

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

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 DUCTWORK

.1 Ductwork shall be constructed to maximum static pressure that the associated fans can produce.

.2 Material:

.1 All ductwork to be aluminium as per ASTM B209.

.2 Thickness: to SMACNA.

.3 Construction: round.

.1 Ducts: factory fabricated, spiral wound, with matching fittings and specials to SMACNA.

.2 Transverse joints up to 900 mm: slip type with tape and sealants.

.3 Transverse joints over 900 mm: Vanstone.

.4 Fittings:

.1 Elbows: smooth radius. Centreline radius: 1.5 times diameter.

.2 Branches: conical transition with conical branch at 45 degrees and 45 degrees elbow.

.4 Construction: rectangular:

.1 Ducts: to SMACNA.

.2 Transverse joints: SMACNA seal Class A and B.

.3 Fittings:

.1 Elbows: smooth radius; centreline radius 1.5 times width of duct. No vanes.

.2 Branches: with conical branch at 45 degrees and 45 degrees elbow.

.5 Fire stopping:

.1 50 x 50 x 3 mm retaining angles around duct, on both sides of fire separation.

.2 Fire stopping material must not distort duct.

2.2 SEAL CLASSIFICATION

.1 Classification as follows:

Maximum Pressure (Pa)	SMACNA Seal Class
2500	A
1500	A
1000	A
750	B

.2 Seal classification:

.1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.

.2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant.

2.3 SEALANT

.1 Oil resistant, water-borne polymer type flame resistant high velocity duct sealing compound.

.1 Temperature range of minus 40 degrees C to plus 93 degrees C.

2.4 TAPE

.1 Tape: polyvinyl treated, open weave fibre glass, 50 mm wide.

2.5 HANGERS AND SUPPORTS

.1 Hangers and supports: in accordance with Section 23 05 29- Hangers and Supports for HVAC Piping Equipment.

.1 Band hangers: use on round and oval ducts up to 500 mm diameter, of same material as duct but next sheet metal thickness heavier than duct.

.2 Trapeze hangers: ducts over 500 mm diameter or longest side, to SMACNA.

.3 Hangers: aluminum rods to SMACNA and following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

.4 Upper hanger attachments:

.1 For concrete: manufactured concrete inserts.

.2 For steel joist: manufactured joist clamp.

.3 For steel beams: manufactured beam clamps:

Part 3 Execution

3.1 GENERAL

.1 Do work in accordance with SMACNA.

.2 Do not break continuity of insulation vapour barrier with hangers or rods.

.3 Support risers in accordance with SMACNA.

.4 Install breakaway joints in ductwork on sides of fire separation.

3.2 HANGERS

.1 Band hangers: install in accordance with SMACNA.

.2 Angle hangers: complete with locking nuts and washers.

.3 Hanger spacing: in accordance with SMACNA as follows:

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

3.3 SEALING AND TAPING

.1 Apply sealant in accordance with manufacturer's recommendations and SMACNA.

.2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturer's recommendations.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11- Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11- Cleaning.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for duct accessories including flexible connections, access doors, vanes and collars.

.2 Related Sections:

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 78 00 - Closeout Submittals.

1.2 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Material Safety Data Sheets (MSDS).

.2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

.1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 95.

.3 ASTM International

.1 ASTM A240-15 Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

1.3 SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:

.1 Flexible connections.

.2 Duct access doors.

.3 Turning vanes.

.4 Instrument test ports.

.3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.1 Certification of ratings: catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

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

.5 Instructions: submit manufacturer's installation instructions.

.6 Manufacturer's Field Reports: manufacturer's field reports specified.

.7 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 GENERAL

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

2.2 FLEXIBLE CONNECTIONS

.1 Frame: stainless sheet metal frame with fabric clenched by means of double locked seams.

.2 Material:

.1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, density of 1.3 kg/m^2.

2.3 ACCESS DOORS IN DUCTS

.1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.

.2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.

.3 Gaskets: neoprene.

.4 Hardware:

.1 Up to 300 x 300 mm: two sash locks.
.2 301 to 450 mm: four sash locks complete with safety chain.
.3 451 to 1000 mm: piano hinge and minimum two sash locks.
.4 Doors over 1000 mm: piano hinge and two handles operable from both sides.

2.4 TURNING VANES

.1 Factory or shop fabricated to recommendations of SMACNA and as indicated.

2.5 INSTRUMENT TEST

.1 1.6 mm thick steel zinc plated after manufacture.

.2 Cam lock handles with neoprene expansion plug and handle chain.

.3 28 mm minimum inside diameter. Length to suit insulation thickness.

.4 Neoprene mounting gasket.

2.6 SPIN-IN COLLARS

.1 Conical stainless sheet metal spin-in collars with lockable butterfly damper.

.2 Sheet metal thickness to co-responding round duct standards.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 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 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 Instrument Test Ports:

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

.4 Turning vanes:

.1 Install in accordance with recommendations of SMACNA and as indicated.

3.3 CLEANING

.1 Perform cleaning operations as specified in Section 01 74 11 - Cleaning and in accordance with manufacturer's recommendations.

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Balancing dampers for mechanical forced air ventilation and air conditioning systems.

1.2 REFERENCES

.1 Sheet Metal and Air Conditioning National Association (SMACNA)

.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible.

Part 2 Products

2.1 GENERAL

.1 Manufacture to SMACNA standards.

2.2 SPLITTER DAMPERS

.1 Fabricate from same material as duct but one sheet metal thickness heavier, with appropriate stiffening.

.2 Single thickness construction.

.3 Control rod with locking device and position indicator.

.4 Rod configuration to prevent end from entering duct.

.5 Pivot: piano hinge.

.6 Folded leading edge.

2.3 SINGLE BLADE 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 (4 inch).

.3 Locking quadrant with shaft extension to accommodate insulation thickness.

.4 Inside and outside bronze end bearings.

.5 Channel frame of same material as adjacent duct, complete with angle stop.

2.4 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 inch).

.4 Bearings: pin in bronze bushings.

.5 Linkage: shaft extension with locking quadrant.

.6 Channel frame of same material as adjacent duct, complete with angle stop.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install where indicated.

.2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.3 Locate balancing dampers in each branch duct, for supply, return and exhaust systems.

.4 Runouts to registers and diffusers: install multi-blade damper located as close as possible to main ducts.

.5 Dampers: vibration free.

.6 Ensure damper operators are observable and accessible.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Operating dampers for mechanical forced air ventilation and air conditioning systems.

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM)

.1 ASTM A653/A653M-04a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

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 Indicate the following:

.1 Performance data.

.2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

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

.2 Instructions: submit manufacturer's installation instructions.

.3 Closeout Submittals

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

Part 2 Products

2.1 BACK DRAFT DAMPERS

.1 Automatic gravity operated, multi leaf, aluminum construction with nylon bearings, as indicated.

2.2 MOTORIZED DAMPERS

.1 Extruded aluminum (6063-T5) damper frame shall not be less than 0.080” (2.03 mm) in thickness. Damper frame shall be 4” (101.6 mm) deep x 1" (25.4 mm), with duct mounting flanges on both sides of frame. Damper frame shall have a 2" (50.8 mm) mounting flange on the rear of the damper, when installed as Extended Rear Flange install type. Frame to be assembled using zinc-plated steel mounting fasteners.

.2 Blades shall be maximum 6.4" (162.6 mm) deep extruded aluminum (6063-T5) air-foil profiles with a minimum wall thickness of 0.06” (1.52mm). Blades shall be internally

insulated with expanded polyurethane foam and shall be thermally broken. Complete blade shall have an insulating factor of R-2.29 and a temperature index of 55 (tested to AAMA 1502.7 Test Method).

.3 Blade seals shall be extruded silicone or EPDM as indicated on the plans. Seals shall be secured in an integral slot within the aluminum blade extrusions and shall be mechanically fastened to prevent shrinkage and movement over the life of the damper.

.4 Frame seals shall be extruded silicone, secured in an integral slot within the aluminum frame extrusions and shall be mechanically fastened to prevent shrinkage and movement over the life of the damper. Metallic compression type jamb seals will not be approved.

.5 Bearings shall be a dual bearing system composed of a Celcon inner bearing (fixed around a 7/16" (11.11 mm) aluminum hexagon blade pivot pin), rotating within a polycarbonate outer bearing inserted in the frame. Single axle bearing, rotating in an extruded or punched hole shall not be acceptable.

.6 Hexagonal control shaft shall be 7/16" (11.11 mm). It shall have an adjustable length and shall be an integral part of the blade axle. A field-applied control shaft shall not be acceptable. All parts shall be zinc-plated steel.

.7 Linkage hardware shall be aluminum and corrosion-resistant zinc-plated steel, installed in the frame side, out of the airstream, and accessible after installation. Linkage hardware shall be complete with cup-point trunnion screws to prevent linkage slippage. Linkage that consists of metal rubbing metal will not be approved.

.8 Dampers shall be designed for operation in temperatures ranging from -40°F (-40°C) to 212°F (100°C).

.9 Dampers shall be AMCA rated for Leakage Class 1A at 1 in w.g. (0.25 kPa) static pressure differential. Standard air leakage data to be certified under the AMCA Certified Ratings Program.

.10 Dampers shall be opposed blade action or parallel blade action as indicated on the plans.

.11 Dampers shall be installed in Flanged to Duct, Installed in Duct, or Extended Rear Flange as indicated on the plans.

.12 Damper actuators shall be side mounted and outside of the air stream unless otherwise indicated on the drawings or specifications.

.13 Materials shall be suitable for the service and environment to which they are exposed.

.14 Acceptable Products: Refer to motorized damper schedule on Drawings or approved equal in accordance with B8.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install 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.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Supply, installation, and commissioning of fans, motors, accessories, and hardware.

1.2 REFERENCES

.1 Air Conditioning and Mechanical Contractors (AMCA)

.1 AMCA Publication 99-2003, Standards Handbook.

.2 AMCA 300-1996, Reverberant Room Method for Sound Testing of Fans.

.3 AMCA 301-1990, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)

.1 ANSI/AMCA 210-1999, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB 1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.3 SYSTEM DESCRIPTION

.1 Performance Requirements:

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

.2 Capacity: flow rate, static pressure, bhp, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.

.3 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.

.4 Sound ratings: comply with AMCA 301, tested to AMCA 300. Supply unit with AMCA certified sound rating seal.

.5 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210. Supply unit with AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet. Include product characteristics, performance criteria, and limitations.

.2 Shop Drawings:

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

.3 Provide :

.1 Fan performance curves showing point of operation, BHP and efficiency.

.2 Sound rating data at point of operation.

.4 Indicate:

.1 Motors, sheaves, bearings, shaft details.

.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 HVAC fans for incorporation into manual.

1.5 MAINTENANCE

.1 Extra Materials:

.1 Provide the following maintenance materials:

.1 Spare parts to include:

.1 Matched sets of belts.

Part 2 Products

2.1 FANS GENERAL

.1 Motors:

.1 In accordance with Section 23 05 13 - Common Motors Requirements for HVAC Equipment supplemented as specified herein.

.2 Sizes as specified.

.2 Accessories and hardware: matched sets of V-belt drives, adjustable slide rail motor bases, belt guards, coupling guards fan inlet and outlet safety screens as indicated and as specified in Section 23 05 13 - Common Motor Requirements for HVAC Equipment.

.3 Factory primed before assembly in colour standard to manufacturer.

.4 Scroll casing drains: as indicated.

.5 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

.6 Vibration isolation: as per manufacturer’s requirements.

.7 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

.8 Surface Finish: Hi-Pro Polyester.

.9 Fan Blade Coating: Hi-Pro Polyester.

.10 Suitable for operating in a corrosive atmosphere.

2.2 EXHAUST FANS – (EF-6120)

.1 Performance:

.1 Refer to Mechanical Equipment Schedule Drawing.

.2 Type: Belt Driven Centrifugal Inline

.3 Input Power – 575/3/60

.4 Model: Greenheck BSQ-180-30 or approved equivalent in accordance with section B8.

2.3 EXHAUST FANS – (EF-6220)

.1 Performance:

.1 Refer to Mechanical Equipment Schedule Drawing

.2 Type: Belt Driven Centrifugal Inline

.3 Input Power – 575/3/60

.4 Model: Greenheck BSQ-240-30 or approved equivalent in accordance with section B8.

2.4 EXHAUST FANS – (EF-6320)

.1 Performance:

.1 Refer to Mechanical Equipment Schedule Drawing

.2 Type: Belt Driven Centrifugal Inline

.3 Input Power – 575/3/60

.4 Model: Greenheck BSQ-130-20 or approved equivalent in accordance with section B8.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 FAN INSTALLATION

.1 Install fans as indicated, complete with resilient mountings, flexible electrical leads and flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.

.2 Provide sheaves and belts required for final air balance.

.3 Bearings and extension tubes to be easily accessible.

.4 Access doors and access panels to be easily accessible.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Supply, return and exhaust grilles and registers, diffusers, and linear grilles.

1.2 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 Indicate following:

.1 Capacity.

.2 Throw and terminal velocity.

.3 Noise criteria.

.4 Pressure drop.

.5 Neck velocity.

Part 2 Products

2.1 GENERAL

.1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity.

.2 Frames:

.1 Full perimeter gaskets.

.3 Concealed manual volume control damper operators.

.4 Colour: as indicated on grille schedule.

.5 Acceptable Manufacturer: “E.H. Price Ltd”, as per grille schedule or approved equivalent in accordance with B8.

2.2 MANUFACTURED UNITS

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

2.3 GRILLE SCHEDULE

.1 As indicated on Drawings.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install in accordance with manufacturers instructions.

.2 Install with stainless steel (or colour matched) screws in countersunk holes where fastenings are visible.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Supply, delivery, receiving, installation, and commissioning of the air handling units specified herein.

1.2 REFERENCES

.1 American National Standards Institute/Air-Conditioning and Refrigeration Institute (ANSI/ARI)

.1 ANSI/ARI 430-99(R2002), Central-Station Air-Handling Units.

.2 American Society of Heating, Refrigeration and Air Condition Engineers (ASHRAE)

.1 ANSI/ASHRAE 90.1-2010, (I-P) Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 ANSI/ASHRAE 52.2-2007, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB 1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.4 Green Seal Environmental Standards (GSES)

.1 Standard GS-11-07, Environmental Standard for Paints.

.5 Master Painters Institute (MPI)

.1 MPI-INT 5.3-2007, Galvanized Metal.

.6 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD)

.1 SCAQMD Rule 1113-04, Architectural Coatings.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and datasheets for insulation, filters, adhesives, and paints, and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Indicate following: fan, motor drive, voltage, total and sensible cooling, filters, mixing box, dampers, coil; include performance data.

1.4 CLOSEOUT SUBMITTALS

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

1.5 MAINTENANCE MATERIAL SUBMITTALS

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

.2 Provide five spare sets of filters.

.3 Provide list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

Part 2 Products

2.1 MAKEUP AIR UNITS

.1 Performance: See equipment schedule.

.2 Fans: Airfoil

.3 Unit Construction: Heavy gauged galvanized steel.

.4 Filters: MERV 13

.5 Factory Supplied Controls/Wiring

.6 Location: Indoors

.7 Surface Finish:

.1 Surface will be primed with a two-part acid based etching primer. Finish coat shall be an electrostatically applied enamel, to all exposed surfaces. All unprotected metal and welds shall be factory coated.

.8 GENERAL

.1 Air Handling Units shall be built to the level of quality as herein specified and to the description of the Air Handling Unit Schedule.

.2 Substitution of any product other than that specified, must ensure no deviation below the stated capacities, air flow rate, heat transfer rate, filtration efficiency and air mixing quality. Power requirements must not be exceeded, and where specifically defined, sound power levels must not be exceeded. Applications for "equal" or "alternate" must address these factors.

.3 Unless stated otherwise, air-handling units are to be shipped to the job in one piece, factory assembled. Modular units assembled to achieve a close proximation to the intent of this specification will not be considered equal. All equipment shall where specified and applicable, be pre-wired, and factory certified by an approved testing agency such as CETL, ETLUS, UL, CSA prior to shipment. Where noted on the equipment schedule the unit shall be capable of splitting into sections to be removed from the building (See Unit F6210)

.4 Pre-wired air handling units shall bear an approved label with all the necessary identification marks, electrical data, and any necessary cautions as required by the Canadian Electrical Code.

.5 All electrical circuits shall undergo a dielectric strength test, and shall be factory tested and checked as to proper function.

.6 The air handling units and major components shall be products of manufacturers regularly engaged in the production of such equipment and with a minimum of fifteen continuous years of proven production experience.

.7 Air Handling Units shall be as manufactured by Engineered Air and be base bid. Alternate products must show savings and clearly indicate all areas where they do not meet specified product.

.9 UNIT CONSTRUCTION

.1 Unit casing shall be of minimum 18-gauge (1.3mm) satin coat galvanized sheet metal. Surfaces shall be cleaned with a degreasing solvent to remove oil and metal oxides and primed with a two-part acid based etching primer. Finish coat shall be an electrostatically applied enamel, to all exposed surfaces. All unprotected metal and welds shall be factory coated.

.2 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.

.3 Units shall be provided with access doors to the following components: fans and motors, filters, dampers and operators, access plenums, electrical control panels, burner compressor compartments. Access doors shall be large enough for easy access. Removal of screwed wall panels will not be acceptable.

.4 Units shall be provided with hinged access doors, with extruded neoprene gasket, fully lined, and a minimum of two Leverlok handles, operable from both sides for all units.

.5 All units shall be internally insulated with 1"(25mm) thick 1 1/2 lb./cu.ft. (24 kg./cu.m.) density, neoprene coated fibre glass thermal insulation.

.6 1 1/2 lb./cu.ft. (24 kg/cu.m.)insulation shall be secured to metal panels with a fire-retardant adhesive and welded steel pins at 16" (400mm) o/c. All longitudinal insulation joints and butt ends shall be covered by a sheet metal break to prevent erosion of exposed edges. Drain pans and all floor areas shall be insulated on the underside.

.7 The following components shall be provided with a 22 gauge (.85mm) solid galvanized metal liner over insulated areas: Fan Sections, Coil Sections, Filter Sections, Access Sections, Underside of Unit (where visible)

.8 Wash down liner shall be screwed and caulked to allow for power washing without risk of wetting the internal insulation. Solid liner shall be broken over 2” (51mm) drain pan upturn to allow water to shear into pan (see floor as drain pan).

.9 The interior of casing painted in immersion duty two-part epoxy and the exterior painted to match the air handler

.10 FANS

.1 Centrifugal fans shall be rated in accordance with AMCA Standard Test Code, Bulletin 210. Fan manufacturer shall be a member of AMCA. All fans and fan assemblies shall be dynamically balanced during factory test run. Fan shafts shall be selected for stable operation at least 20% below the first critical RPM. Fan shafts shall be provided with a rust inhibiting coating.

.2 Single low pressure forward curved fans shall be equipped with greaseable pillow block bearings, supported on a rigid structural steel frame.

.3 Motor, fan bearings and drive assembly shall be located inside the fan plenum to minimize bearing wear and to allow for internal vibration isolation of the fan-motor assembly, where required. Motor mounting shall be adjustable to allow for variations in belt tension.

.4 Fan-motor assemblies shall be provided with vibration isolators. Isolators shall be bolted to steel channel welded to unit floor, which is welded to the structural frame of the unit. The isolators shall be neoprene-in-shear type for single 9" (230mm) to 15" (380mm) diameters forward curve fans. All other fans shall incorporate vertical

spring type isolators with leveling bolts, bridge bearing waffled pads with minimum 1" (25mm) static deflection designed to achieve high isolation efficiency. Fans shall be attached to the discharge panel by a polyvinyl chloride coated polyester woven fabric, with a sealed double locking fabric to metal connection.

.5 Fan motors shall be ODP super high efficiency type.

.11 GAS HEAT SECTION (DJ) - Indirect Fired

.1 General

.1 Heating units shall be indirect natural gas fired approved for both sea level and high-altitude areas. The entire package, including damper controls, fan controls, and all other miscellaneous controls and accessories shall be approved by an independent testing authority and carry the approval label of that authority as a complete operating package.

.2 All units must exceed the ASHRAE 90.1 requirement of steady state efficiency at low fire.

.3 Operating natural gas pressure at unit(s) manifold shall be 7"w.c.(1750 Pa).

.4 Gas fired units shall be approved for operation in -40°F(-40°C). Packaged controls to allow operation below 40°F(-40°C) that shutdown at 40°F(-40°C) by control package is not acceptable.

.2 Heat Exchanger/Burner Assembly

.1 Heat exchanger shall be a primary drum and multi-tube secondary assembly constructed of titanium stainless steel with multi-plane metal turbulators and shall be of a floating stress relieved design. Heat exchanger shall be provided with condensate drain connection. The heat exchanger casing shall have 1"(25mm) of insulation between the outer cabinet and inner heat reflective galvanized steel liner. Blower location shall be engineered to improve the required air flow pattern around the heat exchanger. Using duct type furnaces and closed coupled blowers are not acceptable.

.2 The heat exchanger/burner assembly shall be a blow through positive pressure type. Units incorporating the DJM module shall have an interrupted pilot ignition system to provide increased safety. Units using continuous or intermittent pilots are not acceptable.

.3 Flame surveillance shall be from the main flame after ignition not the pilot flame. The burner and gas train shall be in a cabinet enclosure. Atmospheric burners or burners requiring power assisted venting are not acceptable.

.4 The heat exchanger/burner assembly shall include 15:1 turndown for all input ranges from 100MBH to 1400MBH (29.3 kW to 410 kW). The high turn down heat exchanger/burner assembly minimum input shall be capable of controlling 6.7% of its rated input, excluding the pilot assembly, without on/off cycling and include built in electronic linearization of fuel and combustion air. Efficiency shall increase from high to low fire.

.3 Controls

.1 Electronic CDXM module (Modulating Fuel w/ Modulating Combustion Air) complete with proportional and integral control with discharge air sensor to maintain set point temperature and provide rapid response to incremental changes in discharge air temperature. Combustion air motor speed varies proportionally in response to the modulation of gas flow to provide optimum

fuel/air mixture and efficiency at all conditions. Combustion blower RPM shall be proved using a hall effect speed sensor. Two speed or step speed combustion blowers are not acceptable.

.2 Combustion efficiency of high efficiency heat exchangers shall increase by up to 4 5% from high fire to low fire while turning down on units incorporating 15:1 turndown (HT Burner). Heat exchangers shall provide a minimum of 80% efficiency throughout the entire operating range.

.3 Alternate manufacturers units that do not incorporate a variable speed combustion air blower shall have a modulating gas valve and a combustion air damper with a linear linkage connected to an actuator which has a minimum of 100 steps of control.

.4 Controllers for heating only units incorporating the DJM3 module shall include the following standard features:

.5 Service analyzer with diagnostic lights for ease of set-up and service

.6 linear gas and combustion air flow obtained via a built in solid-state linear algorithm

.7 -40°F(-40°C) minimum operating ambient temperature

.8 Heating control function shall be modulating discharge air control.

.9 Discharge air sensor shall be field mounted in supply ductwork.

.10 Unit shall accept inputs from the DDC system to start/stop the unit, reset the discharge air temperature and modulate the mixed air dampers.

.12 FILTERS

.1 Filter sections shall be provided with adequately sized access doors to allow easy removal of filters. Filter removal shall be from one side as noted on the drawings.

.2 The filter modules shall be designed to slide out of the unit. Side removal 2" (50mm) filters shall slide into a formed 316 Stainless steel metal track, sealing against metal spacers at each end of the track.

.3 2"(50mm) Pleated Panel Disposable Filters: An optimum blend of natural and synthetic fiber media with a 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. The filter media shall have a minimum of MERV 13 per ASHRAE 52.2. Rated U.L. Class 2.

.13 COILS

.1 Coils shall be 5/8" O.D. and/or 1/2" O.D. as manufactured by Engineered Air, constructed of Copper tube, aluminum fin, and copper headers with schedule 40 steel pipe connectors.

.2 Fins constructed of aluminum or copper shall be rippled for maximum heat transfer and shall be mechanically bonded to the tubes by mechanical expansion of the tubes. The coils shall have a galvanized steel casing. All coils shall be factory tested with air at 300 psig (2070 kPa) while immersed in an illuminated water tank.

.3 Headers shall be outside the air-handling unit for maximum serviceability except for blow through applications where headers are internal. The non-headered end of the coil shall be fully concealed. Provide auxiliary drain pan complete with ½" (13mm) MPT drain connection at headered end of cooling coils.

.4 Coils shall be removable from the unit at the header end, unless shown otherwise on the drawings. All water coils shall be equipped with a capped vent tapping at

the top of the return header or connection, and a capped drain tapping at the bottom of the supply header or connection.

.5 Water and glycol coils shall be circuited to provide adequate tube velocities to meet design requirements. Internal turbulators are not acceptable.

.6 5/8" O.D. tube diameter water coils shall be ARI Certified.

.7 Reclaim and preheat coils constructed with a 18 Gauge 316 Stainless steel tube sheet.

.8 Provide Heresite P-413C, a pure phenolic with plasticizers thermosetting resinous coating to protect the coils against exposure to corrosive atmospheres. The process shall be accomplished by a multiple coat application of degreasing and etching, dipping and baking (four times), resulting in complete coating

.14 DAMPERS

.1 Remote mounted to the unit not included. Refer to Mechanical Equipment Schedule Drawings.

2.2 MUA-F6110

.1 Air handling unit schedule:

- .1 Heat Exchanger/Burner Section
  - .1 Discharge orientation: Top
  - .2 Access: Front
- .2 Electrical Panel
  - .1 Access: Side
- .3 Blower/Motor Section
  - .1 Access: Front
- .4 Inlet air/Filter Section
  - .1 Suction Orientation: Top
  - .2 Filter: Perpendicular to air flow
  - .3 Access: Side

.2 Heating Coil Schedule:

- .1 Type: Indirect Natural Gas Fired
- .2 Efficiency:

.1 Access: Side

.4 4-Row Water-Glycol Section

.1 Access: Side

.5 Filter/Mixing Section

.1 Suction Orientation: Top

.2 Filters: V Bank

.3 Access: Side

.2 Heating Coil Schedule:

.1 Type: Indirect Natural Gas Fired

.2 Duty: Primary Heating

.3 Efficiency: 81%

.4 Combustion Air: Separated Combustion

.3 Preheating Coil Schedule:

.1 Type: Hydronic Coil

.2 Duty: Heat Recovery

.3 Cold Side Properties

.1 Fluid: 50% Propylene Glycol

.4 Hot Side Properties

.1 Fluid: Exhaust Air

.2 Inlet Temperature: 78°F @ RH: 40%

.4 Acceptable product: Engineered Air DJS140/V or approved equal in accordance with B8.

2.4 MAKEUP AIR UNITS (MUA-F6310)

.1 Air handling unit schedule:

.1 Heat Exchanger/Burner Section

.1 Discharge orientation: Front

.2 Access: Side

.2 Electrical Panel

.1 Access: Back

.3 Blower/Motor Section

.1 Access: Side

.4 4-Row Water-Glycol Section

.1 Access: Side

.5 Filter/Mixing Section

.1 Suction Orientation: Top

.2 Filters: V Bank

.3 Access: Side

.2 Heating Coil Schedule:

.1 Type: Indirect Natural Gas Fired

.2 Duty: Primary Heating

.3 Efficiency: 81%

.4 Combustion Air: Separated Combustion

.3 Preheating Coil Schedule:

.1 Type: Hydronic Coil

.2 Duty: Heat Recovery

.3 Cold Side Properties

.1 Fluid: 50% Propylene Glycol

.4 Hot Side Properties

.1 Fluid: Exhaust Air

.2 Inlet Temperature: 78°F @ RH: 40%

.4 Acceptable product: Engineered Air DJS40/V or approved equal in accordance with B8.

Part 3 Execution

3.1 APPLICATION

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

3.2 INSTALLATION

.1 Provide appropriate protection apparatus.

.2 Install units in accordance with manufacturer's instructions and as indicated.

.3 Ensure adequate clearance for servicing and maintenance.

3.3 FANS

.1 Install fan sheaves required for final air balance.

.2 Install flexible connections at fan inlet and fan outlets.

.3 Install vibration isolators.

END OF SECTION

PART 1 General

1.1 REFERENCE STANDARDS

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM C547, Specification for Mineral Fiber Pipe Insulation.

.3 Canadian Standards Association International (CSA)

.1 CSA B52, Mechanical Refrigeration Code.

.2 CSA C656, Performance Standard for Split-System and Single-Package Central Air Conditioners and Heat Pumps.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 – Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for air conditioning components and accessories and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Indicate on drawings:

.1 Major components and accessories including sound power levels of units.

.2 Type of refrigerant used.

1.3 CLOSEOUT SUBMITTALS

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

.2 Operation and Maintenance Data: submit operation and maintenance data for air conditioning components for incorporation into manual.

1.4 DELIVERY, STORAGE, AND HANDLING

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

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

.3 Storage and Handling Requirements:

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

.2 Store and protect air conditioning components from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Dispose of waste materials in accordance with Section 01 74 21 – Construction / Demolition Waste Management and Disposal.

1.5 WARRANTY

.1 Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

.2 Warranty: Commencing on Date of Installation.

.1 Compressor: 5 years.
.2 Other Covered Components: 1 year.

PART 2 Products

2.1 SPLIT SYSTEM AIR CONDITIONERS (CDR-F6211, U-F6211)

.1 General:

.1 Split System Air Conditioner Units as follows:
.2 All units to be factory assembled, wired and piped.
.3 All units to be factory tested prior to shipping.
.4 Cooling only unit.
.5 Performance: as scheduled.
.6 Electrical: as scheduled.
.7 Dimensions: as scheduled.

.2 Configuration:

.1 Wall mounted indoor unit.
.2 Outdoor wall mounted condensing units.

.3 Refrigerant Charge:

.1 Charge refrigerant system at factory, seal and test.
.2 Holding charge of refrigerant applied at factory.
.3 Refrigerant: R-410A.

.4 Indoor Unit:

.1 Wall mounted evaporator unit. Painted steel housing.
.2 Motorized air distribution vanes with selectable distribution pattern.
.3 Multi-speed circulation fan.
.4 Washable filter.
.5 Copper tube coil with aluminum fins, non-corroding condensate drain pan.

.5 Condensing Unit:

.1 Inverter condensing unit. Painted steel housing.
.2 Dual propeller style condenser fans with variable speed motors.
.3 Inverter driven refrigerant condenser.
.4 Copper tube coil with aluminum fins, non-corroding condensate drain pan.

.5 Provide wall mounting brackets in accordance with manufacturer's recommendations.

.6 Provide low ambient kit complete with wind guards to allow for operation to -40F.

.6 Controls:

.1 Indoor and outdoor unit complete with integral control boards.

.2 Wall mounted controller with temperature set-point adjustment, and control of fan speed and air distribution pattern, filter monitor. Local digital display of room temperature and set-point. Programmable 7-day with.

.3 Controllers to provide complete diagnostic capabilities and display error codes.

.7 Acceptable Product: as scheduled

.8 Acceptable Manufacturers: Daikin, LG, Mitsubishi, Carrier, or approved equal in accordance with B8.

PART 3 Execution

3.1 EXAMINATION

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

.1 Inform Consultant of unacceptable conditions immediately upon discovery.

.2 Proceed with installation only after unacceptable conditions have been remedied.

3.2 GENERAL

.1 Install as indicated, to manufacturer's recommendations.

.2 Manufacturer to certify installation.

.3 Run drain line from cooling coil condensate drain pan to terminate over nearest floor drain.

3.3 EQUIPMENT PREPARATION

.1 Provide services of manufacturer's field engineer to set and adjust equipment for operation as specified.

3.4 INSTALLATION

.1 Install air conditioner in accordance with manufacturer's instructions and regulations of authorities having jurisdiction.

.2 Installer must:

.1 Set air conditioner.

.2 Connect refrigerant lines.

.3 Make electrical connections.

.3 Run drain line from cooling coil condensate drain pan to terminate over nearest floor drain.

3.5 CLEANING

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

.1 Leave Work area clean at end of each day.

.2 Upon completion remove surplus materials, rubbish, tools, and equipment.

3.6 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by air conditioning components installation.

END OF SECTION

Part 1 General

1.1 SCOPE

.1 Supply, delivery, receiving, installation, and commissioning of the unit heaters specified herein.

1.2 REFERENCE STANDARDS

.1 ASTM International (ASTM)

.1 ASTM E 84-11a, Standard Test Method for Surface Burning Characteristics of Building Materials.

.2 ASTM C 916-1985(R2007), Standard Specification for Adhesives for Duct Thermal Insulation.

.3 ASTM C 1071-05e1, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).

.2 National Fire Protection Association (NFPA)

.1 NFPA 90A-2012, Standard for the Installation of Air Conditioning and Ventilating Systems.

.2 NFPA 90B-2012, Standard for the Installation of Warm Air Heating and Air Conditioning Systems (ANSI).

.3 Underwriters' Laboratories (UL) Inc.

.1 UL 2021-1997, Fixed and Location-Dedicated Electric Room Heaters.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section [01 33 00 - Submittal Procedures].

.2 Product Data:

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

.3 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence, and cleaning procedures.

.4 Shop Drawings:

.1 Indicate on drawings:

.1 Equipment, capacity and piping connections.

.2 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.

1.4 CLOSEOUT SUBMITTALS

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

.2 Operation and Maintenance Data: submit operation and maintenance data for unit heaters for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with 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 unit heaters from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 UNIT HEATER (UH-F6240, UH-F6241, UH-F6242, UH-F6243, UH-F6340, F6341, F6342)

.1 Performance:

.1 Refer to Mechanical Equipment Schedule in Drawings.

.2 Cabinet Unit Heaters: to UL 2021

.3 Combustion Air: Separated.

.4 Venting: Install to meet CSA B1491 requirements

.5 Surface Finish: Painted.

.6 Fuel: Natural Gas

.7 Heat Exchanger: Stainless Steel

.8 Fan Blade Coating: Painted.

Part 3 Execution

3.1 EXAMINATION

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

3.2 INSTALLATION

.1 Install in accordance with manufacturer's instructions.

.2 Include double swing pipe joints as indicated.

.3 Check final location with Contract Administrator if different from that indicated prior to installation.

.1 Should deviations beyond allowable clearances arise, request and follow Contract Administrator's directive.

.4 Clean finned tubes and comb straight.

.5 Provide supplementary suspension steel as required.

.6 Install thermostats in locations indicated.

.7 Before acceptance, set discharge patterns and fan speeds to suit requirements.

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 unit heaters installation.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Supply, installation, and commissioning of the infrared radiant heaters as specified herein.

1.2 REFERENCE STANDARDS

.1 American National Standards Institute (ANSI)/CSA Group

.1 ANSI Z83.19a/CSA 2.35a-2011, Gas-Fired High-Intensity Infrared Heaters.

.2 CSA Group (CSA)

.1 CSA B149.1-10, Natural Gas and Propane Installation Code.

.2 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.

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 radiant heating units and include product characteristics, performance criteria, physical size, finish and limitations.

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

.4 Sustainable Design Submittals:

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 radiant heating units 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 radiant heating units from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 INFRARED RADIANT HEATER (RH-F6140, RH-F6141)

.1 General

.1 Provide CSA approved, packaged factory assembled components consisting of heat exchangers, burners, controls, air filters, vacuum generators, reflectors, fans.

.2 Capacity

.1 Output: 205,000 BTUH.

.2 Gas Supply:

.1 Inlet Pressure, natural gas: Min 5.0”W.C., Max 14”W.C.

.2 Manifold Pressure: 3.5”W.C.

.3 Connection: ½” female NPT.

.3 Electrical characteristics: 120 V, 1 phase, 60 Hz. 1 AMP, 36 inch cord with grounded 3 prong plug.

.4 Type: Low intensity infrared heater. 45 degree reflector. 60 foot length. Design compatible with natural gas fuel.

.5 Flue and Outside Air Connection: 100mmO.D. male connection for flue adapter and outside air.

.6 Provide flue adapter to meet CSA B149.1 requirements.

.3 Burners

.1 Manufactured to ANSI Z83.19/CSA vented infrared heater standards

.2 CGA certified for use with natural gas.

.3 Air-fuel mixture-controlled combustion system designed for compatibility with remote-generated and controlled vacuum.

.4 Fail-safe design to shut off supply of fuel in following situations:

.1 Power failure.

.2 Inadequate pilot flame.

.3 Inadequate vacuum in combustion chamber.

.4 Failure of main fuel valve in open position.

.5 Combustion air terminal compatible with connect of filter and outside air duct.

.6 Electrical control system isolated from combustion air system.

.7 Combustion process operational status indicator lights or observation windows.

.8 Pre-wired burner control system with electric ignition.

.9 Suitable for operation with 115 V AC, single phase, 60 Hz electrical service.

.10 Enamel-finished steel enclosure complete with removable access panels.

.11 Heating output capacity compatible with associated downstream radiant tube.

.12 Centrifugal, direct-drive blower with adequate air flow capacity to accommodate ducted inlet and exhaust air requirements.

.4 Heat Exchanger

.1 Heat exchanger to consist of radiant piping with following features:

.2 Removable, heat and corrosion-resistant joint connections designed to accommodate system expansion/contraction.

.3 Length compatible with upstream burner output capacity.

.4 Heat treated aluminized steel

.5 Reflectors

.1 Polished aluminum construction completes with corrugations and configuration to maximize radiant heat directed toward floor.

.2 Standard lengths to facilitate installation complete with overlaps at joints to accommodate expansion and contraction.

.3 Hangers/supports at spacing recommended by system manufacturer to maintain maximum reflector efficiency.

.4 Side extension reflector complete with supports, retainers, and brackets, to prevent radiant heat from striking adjacent surfaces.

.5 Barrier reflector shield complete with supports, retainers, and brackets, to prevent radiant heat from striking objects beneath radiant piping.

.6 Factory fabricated corners, joints, tees, end caps, and related accessories.

.7 Egg-crate style aluminum grille beneath reflectors complete with supports, shields, as required, to improve aesthetics of radiant heating system and complement reflector design efficiency.

.6 Outside Air Supply

.1 Ducted outside air supply to each burner to provide sealed-combustion system.

.2 Insulation and vapour retarder on duct to prevent condensation.

.3 Duct size to ensure adequate air supply to each burner.

.4 Exterior air inlet terminal complete with bird screen and weatherproof hood.

.5 Flexible duct connector adjacent to burner complete with removable joint clamp at burner.

.7 Controls

.1 Pre-wired control panel complete with transformers, relays, terminal blocks, wiring, circuits, hinged door, visible door-mounted system status lights, steel cabinet complete with baked enamel finish and keyed access.

.2 24 V heating thermostat control of burners complete with radiant heat shields where shown.

.3 Thermostat radiant heat reflector shields, if exposed to radiant heat.

.4 Vacuum switch interlock with vacuum generator.

.8 Acceptable Product: Refer to Mechanical Equipment Schedules or approved equal in accordance with B8.

Part 3 Execution

3.1 EXAMINATION

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

3.2 INSTALLATION

.1 Install infrared radiant system in accordance with CSA B149.1, as recommended by manufacturer and as indicated.

.2 Provide grading of radiant pipe as required.

.3 Make provision for pipe movement caused by normal operation and expansion.

.4 Maintain required clearances from combustibles.

.5 Follow manufacturer's detailed installation, testing, operation and maintenance instructions.

.6 Install thermostats where indicated. Supply heat shields where recommended by manufacturer.

.7 Test radiant system as recommended by manufacturer and required by authorities having jurisdiction. Air test piping for leaks. Check burner safety controls.

.8 Arrange equipment, including burners, vacuum generators, to facilitate removal without dismantling pipe, reflectors, or associated apparatus.

3.3 CLEANING

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

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 This section covers items common to sections of Division 25. This section supplements requirements of Division 1.

1.2 CODES AND STANDARDS

.1 Do complete installation in accordance with the latest version of 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 REFERENCES

.1 City of Winnipeg

.1 Automation Design Guide – 612620-0013-40er-0001 Revision 2.

1.4 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.

.4 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, in accordance with B4.

1.5 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.

1.6 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 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.

1.7 MATERIALS AND EQUIPMENT

.1 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.

.2 Minimum enclosure type to be used is NEMA 12 unless otherwise specified.

1.8 FINISHES

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

.1 Paint indoor switchgear and distribution 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.

1.9 EQUIPMENT IDENTIFICATION

.1 Identify electrical 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.

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters
Size 8	35 x 100 mm	3 lines	5 mm high letters

.3 Wording on nameplates to be approved by Contract Administrator prior to manufacture.

.4 Allow for average of twenty-five (25) letters per nameplate.

.5 Identification to be English.

1.10 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings on both ends of phase conductors of feeders and branch circuit wiring.

.1 Wire tags to be heat shrink type with black letters on white background.

1.11 SUBMITTALS

.1 Prior to delivery of any Products to job Site and sufficiently in advance of requirements to allow ample time for checking, submit Shop Drawings for review as specified in Division 40.

.2 Submit Shop Drawings (including Product Data) for all equipment as required in each Section of this Specification.

.3 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.

.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. 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.

.5 Manufacture of Products shall conform to revised Shop Drawings.

1.12 RECORD DRAWINGS

.1 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 automation equipment.

1.13 O&M MANUAL

.1 Operations and Maintenance Manuals

.1 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 complete 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 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 and associated integration, including:
.1 Printout of the entire PLC program. Printout to be sealed by a professional engineer.
.2 Repair instructions for common issues
.3 Printout of any related design documents, such as interface lists, etc.
.4 CD in a sleeve containing the latest PLC program including configuration software.

.3 HMI Operation and Maintenance Manual:

.1 Provide a manual that contains, at minimum, all pertinent information, drawings and documents associated with the PLC program and associated integration, including:
.1 Complete step-by-step procedures for operation of system including required actions via the HMI.
.2 Operation of computer peripherals, and associated input and output formats.
.3 Emergency, alarm and failure recovery procedures.
.4 Step-by-step instructions for start-up, back-up equipment operation, execution of systems functions and operating modes, including key strokes for each command so that operator need only refer to these pages for keystroke entries required to call up display or to input command.
.5 Repair instructions for common issues.
.6 CD in a sleeve containing the latest HMI programs and configuration software.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 DEFINITIONS

.1 FAT: Factory Acceptance Test

1.2 DESIGN REQUIREMENTS

.1 Develop a demonstration and test procedure, along with test forms, for the FAT.

1.3 SUBMITTALS

.1 Submit the following for review at least 15 Working Days prior to FAT.

.1 Detailed test procedure and test forms for review.

.1 Incorporate all changes to the procedure and test forms requested by the Contract Administrator.

.2 Submit the following, to be received on the date of the FAT:

.1 Detailed listings of all control logic and software utilized to implement the control sequences, for the scenarios demonstrated as part of the FAT. Listings are to be neatly organized, and commented as required. All supporting documents, including variable listings are to be included.

1.4 CLOSEOUT SUBMITTALS

.1 Include all FAT documentation and test forms in the O&M manuals.

1.5 DEMONSTRATION AND TESTING

.1 The location of the FAT will be in a Contractor supplied facility, within Winnipeg, Manitoba, Canada.

.2 Correct deficiencies and re-test until satisfactory performance is obtained.

.3 Acceptance of tests during the FAT will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.

1.6 COMPLETION OF FAT

.1 The FAT is considered to be complete only when full approval of the Contract Administrator has been received by the Contractor.

.2 Schedule additional re-tests until approval is obtained.

Part 2 Products

2.1 NONE USED.

.1 None Used.

Part 3 Execution

3.1 DEMONSTRATION SYSTEM

.1 Setup the complete automation system in the Contractor's facility, in a manner to allow for the complete and expeditious testing of the system and associated programming.

.2 Provide simulation software to allow for straightforward expeditious testing of the software. Minimum requirements include:

- .1 Will read outputs from PLC and write inputs into PLC.
- .2 Will provide clear buttons and indicators on graphics screens with descriptive names for manual simulation of all I/O points.
- .3 I/O point control organized in a clear manner by process, as per the P&IDs.
- .4 Scripting to simulate the complete process, including but not limited to:
  - .1 Motor run status.
  - .2 Response to analog signals.
  - .3 Flowmeter flow.
  - .4 Damper positions.
  - .5 HVAC temperatures.
- .5 Provide means to override script response to allow for abnormal operation testing.
- .6 Software Package: Vijeo Designer.

.3 Simulation software application files to be turned over with the closeout submittals. Note that a licence to run the simulation files is not necessarily required.

.4 In the event that the simulation software is not deemed to be sufficient by the Contract Administrator, the Contract Administrator may cancel the FAT, and the Contractor must reschedule after completing the simulation software. No extension to the overall schedule.

3.2 PROCEDURES

.1 All tests shall be documented.

.2 Produce test forms to allow for recording the results of the simulations and tests.

.3 All points to the SCADA system will be tested with the assistance of City personnel.

.4 Advise Contract Administrator of the date of testing. Contract Administrator may, at their discretion, observe factory acceptance testing based on the completeness of the submittal or other factors.

- .1 Demonstration tests to include:
  - .1 Complete demonstration of meeting the requirements of the applicable
  - .2 Functional Requirements Specification.
  - .3 Response times to operator actions.
  - .4 Controller processor spare capacity.
  - .5 HMI graphics templates and overall system screen layout.
  - .6 HMI trends.
  - .7 Alarm system capabilities.
  - .8 System programming and configuration capability.

.5 The Contract Administrator may request additional tests and simulations at the FAT.

.6 The Contract Administrator will review the system, simulations, and test results. Incorporate comments and feedback from the Contract Administrator into the system design.

3.3 Evaluation

.1 All evaluations will be pass/fail.

.2 The Contractor is expected to ensure that all required demonstrations are fully operable and meet required specifications, prior to the FAT. Upon failure of a required demonstration in the FAT, the Contractor shall provide subsequent re-tests to the satisfaction of the Contract Administrator.

END OF SECTION

Part 1 General

1.1 SUBMITTALS

.1 Submit commissioning plans and procedures, in writing, at least 20 Working days prior to commissioning.

1.2 CLOSEOUT SUBMITTALS

.1 Final Report:

.1 Include measurements, final settings and certified test results.

.2 Include completed commissioning forms

.3 Bear signature of commissioning technician and supervisor

.4 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications as set during commissioning and submit to the Contract Administrator.

.5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

1.3 COMMISSIONING FORMS

.1 The Contract Administrator will provide a base set of standard commissioning forms. Additional forms will be required, and must be prepared by the Contractor.

.2 Supplement the provided forms as required to make a complete commissioning report package. Utilize the specifications, drawings, and Functional Requirements Specification as the basis for preparation of the additional commissioning forms.

1.4 COMMISSIONING

.1 Carry out commissioning under direction of the Contract Administrator and in the presence of representatives of the Contract Administrator and the City.

.2 Inform, and obtain approval from the Contract Administrator in writing at least 14 days prior to commissioning or each test. Indicate:

.1 Location and part of system to be tested or commissioned.

.2 Testing/commissioning procedures, anticipated results.

.3 Names of testing/commissioning personnel.

.3 Correct deficiencies and re-test until satisfactory performance is obtained.

.4 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.

.5 Perform tests as required.

.6 Refer to Commissioning Plan in Appendix E for additional details regarding commissioning.

1.5 COMPLETION OF COMMISSIONING

.1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by the Contract Administrator.

Part 2 Products

2.1 EQUIPMENT

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

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

.3 Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than 6 months prior to tests.

Part 3 Execution

3.1 STATUS PRIOR TO COMMISSIONING

.1 Prior to commissioning, ensure that the following is completed:

.1 Installation of all panels and completion of all wiring connections.

.2 Testing wiring for continuity from the field device to the control panel.

3.2 PROCEDURES

.1 Provide a minimum of one qualified technician to test and commission the control system.

.2 Test each I/O point from the instrument to the HMI.

.1 Test both states of discrete points.

.2 Test, at minimum, two values for analog points.

.3 Test each piece of equipment individually for complete functionality.

.4 Completely test the E-Stop functionality of each piece of equipment, as provided.

.5 All modifications to the software program, to bypass interlocks or sensors, shall be recorded and documented clearly in a separate document, and the software.

.1 Any software bypasses that remain, prior to leaving site, must be authorized by the Contract Administrator or designated representative.

.6 All deficiencies must be corrected by the Contractor.

.7 Commission each system using procedures prescribed by the Contract Administrator.

.8 Optimize operation and performance of systems by fine-tuning control loops and PID values.

3.3 CALIBRATION

.1 Calibrate all analog instruments utilizing industry standard practices. Document and provided completed calibration forms.

3.4 SYSTEM SOFTWARE

.1 Load PLC system with appropriate program, fully tested and approved as part of the software FAT.

.1 Any changes made to the software after the FAT must be submitted for review and approval of the Contract Administrator.

.2 Any issues identified on site must be communicated to the Contract Administrator. Approval is required prior to making any modifications.

.3 The Contractor is reminded that this facility is critical to operation of the City's wastewater pumping station.

3.5 CHECKLISTS, FORMS, AND REPORTS

.1 Complete checklists, forms, and reports for each instrument, loop, and control device.

.1 Instrument Loop Checklist.

.2 Discrete Device Checklist.

3.6 DEMONSTRATION

.1 Demonstrate to the Contract Administrator operation of systems including sequence of operations under all potential conditions, start-up, shut-down interlocks and lock-outs.

END OF SECTION

Part 1 General

1.1 GENERAL

.1 This Section includes the following:

.1 Description and sequence of operations for the process mechanical systems.

.2 Description and sequence of operations for building mechanical systems.

1.2 INTRODUCTION

.1 The Interim Phosphorous Removal Project goal is to reduce overall total Phosphorous (TP) concentrations within the treated wastewater that is discharged back into the river.

.2 Phosphorous removal is achieved by the dosing of ferric chloride solution (37 to 42% concentration by weight) into the wastewater treatment process under various dosing scenarios:

- Scenario 1 involves dosing to the primary sludge, trucked SEWPCC and WEWPCC sludge and digested sludge
- Scenario 2 involves Scenario 1, plus dosing to effluent after grit removal
- Scenario 4 involves Scenario 1, plus dosing to effluent after bioreactors
- Scenarios 2 and 4 will be run separately from one another, not simultaneously

.3 Sodium hydroxide solution (50% concentration by weight) is dosed to maintain pH in the wastewater treatment process for ferric chloride addition into the sludge streams.

.4 Provisions for both railcar unloading and road truck unloading are provided for ferric chloride chemical.

.5 Only road truck unloading is provided for sodium hydroxide chemical.

.6 The existing rail spurs are modified for chemical unloading. A new railcar shelter for chemical unloading south of the existing railcar shelter is provided. A new ferric chloride chemical storage room east of the existing railcar shelter is provided to house two new chemical storage tanks. A new sodium hydroxide chemical storage building is provided west of the existing dewatering building to house to new chemical storage tanks. Compressed air is used for padding of the railcars during unloading. Flushing water is provided for flushing of chemical piping systems.

.7 The ferric chloride and sodium hydroxide chemicals are pumped to injection points by positive displacement metering pumps.

.8 Ferric chloride chemical is also transferred from the new storage tanks to remote dosing tanks via dedicated positive displacement transfer pumps. These pumps can also be used to transfer from the new storage tanks to the existing storage tanks.

.9 There are remote dosing tanks and chemical metering pumps for the ferric chloride dosing points into the effluent after grit removal (Scenario 2) and effluent after bioreactors (Scenario 4).

1.3 PROCESS MECHANICAL CONTROL NARRATIVE

.1 Ferric Chloride Chemical Delivery and Unloading Description

.1 The railcar unloading process description is as follows:

.1 An insulated and heated shelter is provided for operator comfort and to minimize the potential for freezing (and to thaw out railcars that may arrive frozen during winter).

.2 The existing operational rail spur is maintained to serve existing Railcar Shelter 1.

.3 The existing non-operational rail spur is modified and extended to serve the new Railcar Shelter 2

.4 Two railcars will be directed into the railcar shelters in accordance with CP Rail's spotting procedures. Once the railcars have arrived, the railcar shelter door is opened, and the railcars are safely brought into the shelter. The door is then closed.

.5 Railcar unloading is undertaken through the top connection on the railcar. An unloading platform is provided for access to the top of the railcar and to the compressed air and chemical unloading connections.

.6 Compressed air is used to pad the railcar, and transfer of the ferric chloride to the existing and new storage tanks. The compressed air is supplied from the existing and new air compressors in the Dewatering Building.

.7 Ferric chloride can be transferred to the two existing storage tanks or to the two new storages by opening and closing the appropriate valves.

.8 Chemical unloading can be automatically or manually controlled. A control panel, located next to the unloading platform stairs, contains the unloading controls. Motorized valves are utilized to provide a degree of automation to the chemical unloading.

.9 A chemical spillage collection system consisting of a fiber reinforced plastic (FRP) drip tray is provided for the railcar with drains directed to flow to the containment area in the respective chemical storage rooms (100 or 101C).

.10 Emergency shower and eyewash stations are provided on the platform and the main floor within each railcar shelter.

.11 The ferric chloride is transferred to the existing storage tanks via an underground HDPE pipe within a secondary containment pipe.

.12 New unloading piping is provided between the two-railcar shelter unloading systems to allow for transfer of the chemical from Railcar Shelter 1 or 2 into either the existing or new storage tanks. Chemical piping not located in the containment area is installed within a PVC secondary containment pipe.

.2 The truck unloading description is as follows:

.1 Ferric chloride can also be delivered and transferred to the storage tanks from a road tanker using the truck's own on-board compressed air system that connects to the existing Railcar Shelter 1 truck connection.

.2 Ferric chloride can be transferred to either existing or new storage tanks by opening and closing of the appropriate valves and utilizing the same piping system as the railcar unloading.

.3 An existing spill sump with a bottom drain is provided below the unloading for spill collection. Spills flow into the containment area in the chemical storage building.

.4 An existing isolation valve is installed in the land drainage sewer downstream of a catch basin. This valve is used to isolate the land drainage sewer system during a truck unloading operation.

.2 Ferric Chloride Chemical Storage Description:

.1 The existing chemical storage tanks are used within the existing chemical storage room 100 and have the same operating features as the new chemical storage tanks. Each existing storage tank has a minimum working volume of 70m^3

.2 Two new storage tanks are provided for chemical storage. Both tanks are located in the chemical storage room 101C adjacent to the existing Railcar Shelter 1. Each tank has a minimum working volume of 140 m^3. The total combined storage volume for existing and new tanks is 420 m^3.

.3 Both tanks are placed in the lower level of the chemical storage room 101C. This lower-level functions as a chemical containment area in case of spills.

.4 The main floor of the chemical storage room 101C over the containment area is made of FRP gratings which is resistant to ferric chloride. All leaks and spills are able to pass through the grating into the containment area.

.5 The floor of the containment area slopes towards a sump. A float switch is installed in the sump pit. Once the liquid level in the sump pit reaches the float switch an alarm is activated.

.6 A manually operated butterfly valve is installed in the sump pit, with the stem extended to the main floor level. When in the open position, the valve directs flow into the existing sanitary sewer line. Generally, the liquid collected in the sump pit is flushing water and it can be discharged to the sewer without concern. Small amounts of chemical can also be discharged into the sewer. For a large leak, the valve position would have to be adjusted to control the rate of discharge. Alternatively, a waste disposal firm could be hired to remove the contents of the containment area and connect to an exterior vactor truck hook-up.

.7 Although ferric chloride is stored in two tanks within each storage room, it is normally dosed from only one tank at a time. The tank from which the ferric chloride is being pumped can be selected automatically, or by manually opening and closing the appropriate valves.

.8 Inter-connection piping and isolation valves are provided at the lower level, so that both tanks can be operated as a single unit, if required.

.9 Each tank is equipped with an observation hatch and an access port. A high-level overflow is installed in each tank. The tanks share a common overflow pipe: this means that a tank initially overflows into the other, until both tanks are full, whereupon the overflow is directed to the containment area.

.10 Each tank is also equipped with an ultrasonic level sensor. At low level, an alarm is activated and the dosing pumps stop. At high level, an alarm is activated and ferric chloride unloading stops, by the operation of the three-way valve and the subsequent venting of compressed air from the railcar. This automatic operation of valve is included as an emergency safety precaution. Under normal unloading conditions valve does not operate, as the unloading procedure is managed by the operators.

.11 A submersible level transmitter is also provided for each tank as a backup to the ultrasonic level sensor. When the high level is reached an alarm is activated and the three-way valve vents compressed air from the railcar to the atmosphere.

.12 Each tank has an insulated and heat traced vent line to the outside of the building. If entry is required to the tank, a portable suction fan can be connected to the vent end to draw out any fumes in the tank.

.13 Emergency shower and eyewash stations are provided on the third level service platform and the main floor.

.3 Ferric Chloride Chemical Dosing Description

.1 Three new chemical metering pumps are provided. Two pumps are duty units, and are skid mounted. The third pump for redundancy on the skid.

.2 Each duty pump transfers the ferric chloride to one injection point. However, inter- connections in the discharge lines allow flexibility in the choice of dosing locations for each pump. Adjustment of the dose rate is done manually, either local to the pump or remotely from the Distributed Control System (DCS).

.3 The operation of the gear pumps is interlocked with existing equipment as follows:

.1 The pump that doses to the SEWPCC and WEWPCC trucked sludge is interlocked with an inline magnetic flowmeter, to ensure that chemical is not dosed into the sludge piping when there is no sludge flow.

.2

.3 The pump that doses to the centrate is interlocked with Centrifuges, to ensure that chemical is not dosed into the centrate piping when there is no centrate flow.

.4 A high-pressure switch on the pump discharge shuts down the dosing pumps when the pressure increases above the set-point.

.5 A pressure relief valve is provided in the discharge line for high pressure relief. Activation of the pressure relief valve diverts flow back to the tank.

.6 Back pressure valves are provided on the discharge line of each pump, to ensure that the check valves function properly.

.7 A flow meter is provided on each line, with output to the DCS.

.8 The pumps transfer the ferric chloride solution to two injection points in 25 mm diameter HDPE tubing. A 50 mm diameter PVC containment pipe surrounds the 25 mm diameter tubing.

.9 Chemical is fed to two different injection points:

.1 A discharge line off the SEWPCC and WEWPCC trucked sludge pumps that transfer trucked sludge to the digesters. A chemical injection ring is utilized for chemical dosing.

.2 A centrate line in the Dewatering Building that transfers centrate to the sewer. This is an existing chemical dosing point that is retained.

.4 Ferric Chloride Chemical Transfer Description

.1 Two new chemical transfer pumps are provided. One pump is duty, and one is for standby. Both pumps are skid mounted.

.2 Duty pump transfers the ferric chloride from the new chemical storage tanks to either the existing chemical storage tanks or three new remote 500L chemical dosing tanks.

.3 The operation of the transfer pumps is interlocked with automated valves on the inlet of each tank and tank level transmitters. If any of the dosing tanks indicate filling is required the automated valve will open and the transfer pump will be operated.

.4 A high-pressure switch on the pump discharge shuts down the transfer pumps when the pressure increases above the set-point.

.5 A pressure relief valve is provided in the discharge line for high pressure relief. Activation of the pressure relief valve diverts flow back to the tank.

.6 A flow meter is provided in the main transfer line, with output to the DCS.

.7 The pumps transfer the ferric chloride solution to the dosing tanks and existing storage tanks in a 25 mm diameter HDPE tubing. A 50 mm diameter PVC containment pipe surrounds the 25 mm diameter tubing.

.5 Ferric Chloride Remote Dosing Tanks and Chemical Dosing Description

.1 Three remote dosing tanks with local metering pump skids are provided. Each pump skid has one redundant pump with associated local containment skid.

.2 The three remote dosing tanks and pumps skids are located for chemical dosing into the wastewater treatment process after grit removal, prior to bioreactors and after bioreactors.

.3 The operation of metering pumps is interlocked as follows:

.1 After Grit Removal (Scenario 2): Inline process flow meter within the “WAS” piping system.

.2 After Bioreactors (Scenario 4): Individual inline process flow meters for each train after the bioreactors.

.4 Chemical dosing at each point is achieved as follows:

.1 After Grit Removal (Scenario 2): Chemical injection ring inline of wastewater piping.

.2 After Bioreactors (Scenario 4): Open channel injection header over wastewater conduit.

.5 A high-pressure switch on the pump discharge shuts down the dosing pumps when the pressure increases above the set-point.

.6 A pressure relief valve is provided in the discharge line for high pressure relief. Activation of the pressure relief valve diverts flow back to the respective dosing tank.

.7 A flow meter is provided in the main transfer line, with output to the DCS.

.8 The pumps transfer the ferric chloride solution to the dosing points in a 25 mm diameter HDPE tubing. A 50 mm diameter PVC containment pipe surrounds the 25 mm diameter tubing.

.6 Sodium Hydroxide Chemical Delivery and Unloading Description

.1 The truck unloading description is as follows:

.1 Sodium hydroxide delivered and transferred to the storage tanks from a road tanker using the truck’s own on-board compressed air system that connects to the new Sodium Hydroxide Chemical Storage Building truck connection.

.2 Sodium hydroxide can be transferred to new storage tanks by opening and closing of the appropriate valves.

.3 A new spill sump with a bottom drain is provided below the unloading for spill collection. Spills flow into the containment area in the chemical storage building. A removable cover is provided for the top of the spill

sump to prevent rain water and snow from building up in the pit. Before the road tanker unloads, the cover is removed

.4 An existing isolation valve is installed in the land drainage sewer downstream of a catch basin. This valve is used to isolate the land drainage sewer system during a truck unloading operation.

.7 Sodium Hydroxide Chemical Storage Description

.1 Two new storage tanks are provided for chemical storage. Both tanks are located in the sodium hydroxide chemical storage building (102) adjacent to the existing Dewatering Building. Each tank has a minimum working volume of 40 m^3. The total storage volume for new tanks is 80 m^3.

.2 Both tanks are placed in the lower level of the sodium hydroxide chemical storage building. This lower-level functions as a chemical containment area in case of spills.

.3 The main floor of the sodium hydroxide chemical storage building over the containment area is made of FRP gratings. All leaks and spills are able to pass through the grating into the containment area.

.4 The floor of the containment area slopes towards a sump. A float switch is installed in the sump pit. Once the liquid level in the sump pit reaches the float switch an alarm is activated.

.5 A manually operated butterfly valve is installed in the sump pit, with the stem extended to the main floor level. When in the open position, the valve directs flow into the existing sanitary sewer line. Generally, the liquid collected in the sump pit is flushing water and it can be discharged to the sewer without concern. Small amounts of chemical can also be discharged into the sewer. For a large leak, the valve position would have to be adjusted to control the rate of discharge. Alternatively, a waste disposal firm could be hired to remove the contents of the containment area and connect to an exterior vactor truck hook-up.

.6 Although sodium hydroxide is stored in two tanks, it is normally dosed from only one tank at a time. The tank from which the sodium hydroxide is being pumped can be selected automatically, or by manually opening and closing the appropriate valves.

.7 Inter-connection piping and isolation valves are provided at the lower level, so that both tanks can be operated as a single unit, if required.

.8 Each tank is equipped with an observation hatch and an access port. A high-level overflow is installed in each tank. The tanks share a common overflow pipe: this means that a tank initially overflows into the other, until both tanks are full, whereupon the overflow is directed to the containment area.

.9 Each tank is also equipped with an ultrasonic level sensor. At low level, an alarm is activated and the dosing pumps stop. At high level, an alarm is activated and sodium hydroxide unloading stops, by the operation of the three-way valve. Under normal unloading conditions valve does not operate, as the unloading procedure is managed by the operators.

.10 A submersible level transmitter is also provided for each tank as a backup to the ultrasonic level sensor. When the high level is reached an alarm is activated and the three-way valve vents compressed air from the railcar to the atmosphere.

.11 Each tank has an insulated and heat traced vent line to the outside of the building. If entry is required to the tank, a portable suction fan can be connected to the vent end to draw out any fumes in the tank.

.12 Emergency shower and eyewash stations are provided on the second-floor service platform and the main floor.

.8 Sodium Hydroxide Chemical Dosing Description

.1 Three new chemical metering pumps are provided. Two pumps are duty units, and are skid mounted. The third pump for redundancy on the skid.

.2 Each duty pump transfers the sodium hydroxide to one injection point. However, inter- connections in the discharge lines allow flexibility in the choice of dosing locations for each pump. Adjustment of the dose rate is done manually, either local to the pump or remotely from the Distributed Control System (DCS).

.3 The operation of the gear pumps is interlocked with existing equipment as follows:

.1 The pump that doses to the SEWPCC and WEWPCC trucked sludge is interlocked with an inline magnetic flowmeter, to ensure that chemical is not dosed into the sludge piping when there is no sludge flow.

.2 The pump that doses to the primary sludge is interlocked with an inline magnetic flowmeter downstream of the primary sludge pumps, to ensure that chemical is not dosed into the primary sludge piping when there is no sludge flow.

.4 A high-pressure switch on the pump discharge shuts down the dosing pumps when the pressure increases above the set-point.

.5 A pressure relief valve is provided in the discharge line for high pressure relief. Activation of the pressure relief valve diverts flow back to the tank.

.6 Back pressure valves are provided on the discharge line of each pump, to ensure that the check valves function properly.

.7 A flow meter is provided on each line, with output to the DCS.

.8 The pumps transfer the sodium hydroxide solution to two injection points in 25 mm diameter HDPE tubing. A 50 mm diameter PVC containment pipe surrounds the 25 mm diameter tubing.

.9 Chemical is fed to two different injection points:

.1 A discharge line off the SEWPCC and WEWPCC trucked sludge pumps that transfer trucked sludge to the digesters. A chemical injection ring is utilized for chemical dosing.

.2 A primary sludge line near the digesters. A chemical injection ring is utilized for chemical dosing.

1.4 PROCESS MECHANICAL SEQUENCE OF OPERATIONS

.1 Control Devices

.1 Control panels for the process mechanical systems are located on electrical drawings. Main process control panels are as follows:

.1 Room 100 (Existing Ferric Chloride Chemical Storage)

- Modification to existing control panel to incorporate display of new ferric chloride tanks for truck unloading.

.2 Room 101A (Existing Railcar Shelter 1)

- Modification to existing control panel to incorporate display of new ferric chloride tanks for railcar unloading.

.3 Room 101B (New Railcar Shelter 2)

- New control panel to control railcar unloading and display existing and new ferric chloride tanks for railcar unloading.

.4 Room 101C (New Ferric Chloride Chemical Storage)

- New control panel to control ferric chloride transfer pumps and display existing and new ferric chloride tanks and new remote ferric

chloride dosing tanks.

.5 Building 102 (New Sodium Hydroxide Chemical Storage)

- New control panel to control truck unloading and display new sodium hydroxide tanks for truck unloading.

.2 Chemical Unloading Operations

.1 Ferric Chloride Chemical Railcar Unloading

- Compressed air panel and air padding
- The chemical unloading system is basically a manual operation assisted by some automatic control elements for quick response and easy controlling.
- The controls will allow operators to simultaneously unload two railcars provided the existing Railcar Shelter 1 is unloading to the existing storage tanks and the new Railcar Shelter 2 is unloading to the new storage tanks.
- There is functionality within the piping to allow operators to unload a railcar within Railcar Shelter 1 into new storage tanks or unload a railcar within Railcar Shelter 2 into existing storage tanks. Though this would not allow for simultaneously unloading functions.
- Before starting the unloading process, the operator must first check that the railcar is properly spotted, following the standard spot procedures outlined by CP Rail. The operator must also follow any and all procedures outlined by the chemical supplier.
- Check to ensure the blue flag is in place and that the track is locked out as required.
- Check the railcar ID numbers and placards for accuracy.
- Inspect the railcar and make sure the brakes are set and wheels are chocked.
- Inspect the 250 mm diameter vents at the chemical storage building and the 25 mm diameter vent at the railcar shelter for blockages. Remove any blockages.
- The chemical unloading control system monitors liquid levels in the storage tanks, valve status, unloading air pressure, and unloading flow rate. The tank levels and liquid flow rate are also displayed on the local unloading control panels.
- The system allows for simultaneous filling of both storage tanks; when one tank is full, its inlet valve closes and the other tank continues to fill.
- The control system turns on the "READY TO UNLOAD" indicator when the total available spare capacity in both storage tanks is greater than a preset volume (enough to accommodate a full railcar volume plus a safety margin).
- The operator manually verifies the tank liquid level readings on the unloading control panel.
- The operator manually opens the tank railcar lid and performs a volt test if required on the railcar following the established procedure outlined by the chemical supplier.
- If needed, the operator takes a sample of the chemical.
- The operator closes and secure the hatch bolts evenly.
- The operator removes the blind caps from the air inlet port and the chemical discharge port on the railcar.
- The operator removes the blind cap from the vent port on the tank.

- The operator winches the chemical hose down to the railcar. The operator manually connects the liquid discharge hose to the railcar.
- The operator manually connects the vent hose to the railcar. Ensure the ball valve is closed.
- The operator manually connects the air padding hose to the railcar.
- The operator opens the liquid line isolation valve, ensuring that there is no pressure in the railcar.
- The operator then goes downstairs to the unloading control panel to check and adjust the pressure regulator setting. For the first unloading the pressure can be set at 120 kPa. For subsequent unloading the pressure can be adjusted as desired. The pressure setting must not exceed 240 kPa.
- A high air pressure in the railcar is not desired. The railcar should be unloaded in 4 to 6 hours with a chemical flow rate of 10 to 15 m3/hr. The chemical flow rate is normally high at the beginning and low at the end of the unloading procedure.
- The operator initiates the unloading procedure by pressing the START button on the control panel.
- When unloading starts the operator must monitor the tank liquid level readings on the unloading control panel.
- The control system starts by opening the tank inlet valve for the filling of tank.
- When the valve is confirmed open, the control system operates the three-way air inlet valve so that compressed air is directed to the railcar.
- The operator opens the air flow control valve slowly and begins to pressurize the railcar. A bypass air control valve and can be used in case the main valve is out of order.
- When the chemical begins to flow, the operator checks the whole piping line for leakage.
- The system allows for simultaneous filling of both storage tanks. When one tank becomes full, its inlet valve closes and filling continues in the other tank.
- The operator must stay in attendance with the railcar at all times when the unloading connections are attached. Railcars are not allowed to stand with unloading connections attached after unloading is completed.
- Unloading normally continues until the railcar is empty.
- When the railcar is empty, the air pressure blows out the transfer lines resulting in the flow reading on flow meter dropping to zero together with a drop in unloading air pressure (measured and transmitted on pressure transmitter). Either the flow meter reading or the pressure reading indicates to the control system that the railcar is empty. After a time, delay, the control system then stops air flow by turning the three-way valve to the vent position and vent the railcar pressure to atmosphere. The time delay is required to purge the railcar atmosphere of corrosive gas. The tank inlet valves are closed after operation of the three-way valve.
- The operator manually opens the vent ball valve to relief the railcar pressure.
- Unloading can be manually stopped in progress or when complete by pressing the emergency stop device (ESD) at the railcar unloading panel, truck unloading panel, railcar platform, or in the chemical storage building. This action immediately stops the air flow by venting the compressed air to atmosphere via valve. In addition, the storage tank

valves close, and an alarm initiated. This emergency operation may cause an acidic mist to pass from the railcar to the three-way valve. After an emergency stop, it is necessary for the operator to flush the air piping with water. Water is added into the air piping at the platform for draining through the three-way valve to the spill sump. Draining to the spill sump requires closure and opening of valves. After flushing, the operator uses compressed air to dry the piping.

- The control system, on detecting high unloading air pressure assumes failure, pipe blockage, or incorrect setting of the pressure regulating valve and initiate alarm and shutdown.
- The control system, on detecting high level in either of the storage tanks initiates alarm and shutdown.
- The control system, on detecting failure or non-responsiveness of a control valve initiates alarm and shutdown.
- If leakage is observed in the chemical transfer line, the operator must stop unloading using the ESD. Once the pressure reading reaches zero, valve must be opened to drain chemicals into the sump pit. If leakage occurs in the transfer line ahead of the strainer, open valve to drain chemical into a container. If the strainer clogs, open both valves to drain chemical before replacing or cleaning the strainer.
- The compressed air venting lines are directed both inside and outside of the railcar shelter. The inside venting line terminates at the sump pit with a 25 to 50 mm diameter increaser; the outside venting line terminates at approximately 1000 mm above ground level with bird and insect screen. Valve for venting to outside is normally open. Valve to sump pit is only used in cold weather when there is a risk of freezing.
- To stop unloading a railcar for any reason, all connections must be disconnected. All valves must be tightly closed, and all other openings securely closed.
- Resuming unloading after an ESD or safety shutdown may require bypassing of the "READY TO UNLOAD" interlock. The control system does not turn on the "READY TO UNLOAD" light because the tank level(s) may no longer be low enough. In this case, the DCS operator is provided with a non-latching override for the "READY TO UNLOAD" permissive. Restart of unloading is initiated by pressing the local START button again.
- Once unloading is complete the operator isolates and disconnects the liquid and air lines, ensuring that the system is fully vented prior to disconnecting by checking the local pressure gauge. The operator removes the flexible air piping and hangs it on the rack on the platform.
- The operator disconnects the flexible chemical piping from the railcar, and put the end of the piping into a barrel. The operator attaches the pipe and barrel to the pulley system and winches them away from the railcar.
- The operator reinstalls the blind caps on the railcar using well-lubricated Teflon coated bolts. The operator securely fastens all bolts making sure one flat washer is on the top and the bottom. As soon as the railcar is completely unloaded, all valves must be tightened with a wrench or other suitable tool. The unloading connections must be removed and all other closures made tight.
- A valve is provided so that compressed air can blow out residual chemical from the transfer line. Opening this valve requires one of the chemical storage tank inlet valves be in the OPEN position. The operator opens the valve slowly for a few minutes.
- The operator removes all other equipment from the railcar.

- The operator raises the access walkway and secures it in place with a chain.
- The operator descends from the platform and closes air valve.
- The operator performs an outbound inspection on the railcar by following the established procedures provided by the chemical supplier and railway authorities.
- In addition to the procedures described above, the operator follows procedures provided by the railway authorities and chemical supplier.

.2 Ferric Chloride Chemical Truck Unloading

- The existing truck unloading operations will remain with modifications to allow for a chemical truck to unload into the new chemical storage tanks.

.3 Sodium Hydroxide Chemical Truck Unloading

- Truck unloading is essentially the same process as railcar unloading except that the truck is equipped with its own unloading system (typically air padding) which is manually controlled by the driver.
- The operator needs to first close the valve on the outlet of the catch basin in the land drainage sewer.
- The operator removes the cover over the spill sump under the unloading connection outside the railcar shelter.
- The control system turns on the "READY TO UNLOAD" indicator when the total available spare capacity in both storage tanks is greater than a preset volume (enough to accommodate full truck/trailer volume plus safety margin).
- The operator manually verifies the tank liquid level readings on the unloading control panel.
- The driver manually vents any built-up pressure or vacuum from the truck using the chemical supplier’s procedure.
- The driver manually connects the liquid discharge hose to the truck.
- The driver manually opens the isolation valve for the liquid line.
- The operator initiates unloading by pressing the START button.
- The control system opens the valves for the tank(s) to be filled.
- The driver starts the truck-mounted unloading compressed air system.
- The system allows simultaneous filling of both storage tanks. When one tank is full, its inlet valve closes and filling continues in the other tank.
- Unloading normally continues until the truck is empty. The driver then manually stops the compressed air system.
- When the truck is empty, air pressure blows out the transfer lines resulting in the flow reading dropping to zero together with a drop in unloading air pressure (monitored on the truck). At this time, the control system detects the empty truck and closes the tank inlet valve(s).
- Unloading can be manually stopped in progress, or when complete, by pressing the ESD button at either of the local panels, at the platform, or in the railcar building. This action immediately closes the storage tank inlet valve(s) and initiates an alarm.
- The control system, upon detecting high level in either of the storage tanks, initiates alarm and shutdown.
- The control system detecting failure or non-responsiveness of a control valve initiates alarm and shutdown.
- Resuming unloading after an emergency stop or safety shutdown may require bypassing of the "READY TO UNLOAD" interlock. The control system does not turn on the "READY TO UNLOAD" light because the tank level(s) may no longer be low enough. In this case, the DCS

operator is provided with a non-latching override for the "READY TO UNLOAD" permissive. Unloading is resumed by pressing the local start button again and restarting the blower if it was stopped.

- The driver isolates and disconnects the liquid and air lines at this time, ensuring that the system is fully vented prior to disconnecting.
- The driver closes the isolation valve (WV-702) and disconnects the chemical line.
- The driver locks out or isolates the truck-mounted compressed air system.
- Once unloading is completed, the driver opens the gate valve in the LDS line from the catch basin.
- If there are any chemical drips or leaks the driver flushes it to the spill sump with water. In the winter, flushing water is not used: lime is applied to the spill.
- The driver replaces and tightens the spill sump cover.
- In addition to the procedures described above, the operator and driver are required to follow procedures provided by the chemical supplier.

.3 Main Chemical Storage Operations

.1 Ferric Chloride

- The outlet valves on the tanks are normally open.
- The tank drain valves on the tanks are normally closed.
- Liquid can be transferred from one tank to the other tank by opening the two drain valves and closing the interconnecting valve.
- Normally, one of the two actuated valves is in the OPEN position to direct chemical from one of the storage tanks to the pump skid.
- Piping is arranged such that it is combined into a common header with isolation valves. Chemical can be withdrawn from either of the two storage tanks or directly from the railcar if needed, through operation of the valves.

.2 Sodium Hydroxide

- The outlet valves on the tanks are normally open.
- The tank drain valves on the tanks are normally closed.
- Liquid can be transferred from one tank to the other tank by opening the two drain valves and closing the interconnecting valve.
- Normally, one of the two actuated valves is in the OPEN position to direct chemical from one of the storage tanks to the pump skid.
- Piping is arranged such that it is combined into a common header with isolation valves. Chemical can be withdrawn from either of the two storage tanks or directly from the railcar if needed, through operation of valves.

.4 Ferric Chloride Chemical Transfer Operations

.1 Remote Dosing Tanks

- Filling of remote dosing tanks will be automated and based on the level sensors within the remote dosing tank.
- As the dosing tanks are drawn down the level sensors will trigger the transfer pumps to automatically turn on and open the associated motorized valves.
- Alarms and safeties will be incorporated.

.2 Transfer from New to Existing Tanks

- Pump operation
- Spill Back
- Pressure Relief

.3 Spill Back Operation

- This functionality is to ensure the pump operates above the minimum flow rate in the system and will utilize motorized valves to open discharge ferric chloride back into the tank. These valves will need to be flow control type with modulating actuators.

.4 Pressure Relief Operation

- This functionality will allow pressure relief from the pump operation.

.5 Chemical Dosing Operation

.1 Ferric Chloride Remote Dosing

- There are two ferric chloride remote dosing locations.
  - DP 2.1
  - DP 4.1, 4.2, 4.3
- At initial start-up the pumps require priming. If the duty tank is full, priming occurs naturally due to the head. If the duty tank level is low, and the standby tank is full, a valve is opened to provide priming head to the pumps. If the piping to the pump skid contains fluid, priming of the pumps is not necessary, irrespective of the tank levels.
- In normal operation the COH switch is in the COMPUTER position, and the pump speed is controlled from the DCS/PCS.
- Local speed control can be undertaken with the COH switch in the HAND position.
- The three pumps transfer the ferric chloride to the three injection points, as appropriate. It is likely that, under most conditions, only one or two pumps operate.
- Pressure relief valves on the pump discharge prevent over-pressure of the discharge piping. When activated, the valves direct excess flow to the chemical storage tank(s) through the vent line. Valves control which tank receives the flow.
- Back pressure valves are used to adjust the discharge pressure.
- Pressure switches are used to detect high pressure and shut the pumps down.
- The ultrasonic level sensors monitors the chemical level in the tanks and automatically stops the pumps on low-level and activated an alarm.
- Pump status is output to the DCS.
- A calibration column is provided for calibration of the pumps. The column is normally filled by gravity when the chemical level in the storage tanks is high enough. If the chemical level in both tanks is low, the calibration column can be filled by the pump by opening and closing valves.
- A water supply line is provided for flushing of the pump. Flushing water is fed to the pumps by opening valve. Valves can also be used for draining of the suction lines, but requires opening of valve
- The pump discharges are interconnected; flow can be directed as desired via of valves.
- Pumps are drained via valves.

.2 Ferric Chloride Chemical Metering Pumps

- At initial start-up the pumps require priming. If the duty tank is full, priming occurs naturally due to the head. If the duty tank level is low, and the standby tank is full, valve WV-XXX is opened to provide priming head

to the pumps. If the piping to the pump skid contains fluid, priming of the pumps is not necessary, irrespective of the tank levels.

- In normal operation the COH switch is in the COMPUTER position, and the pump speed is controlled from the DCS/PCS.
- Local speed control can be undertaken with the COH switch in the HAND position.
- The three pumps transfer the ferric chloride to the three injection points, as appropriate. It is likely that, under most conditions, only one or two pumps operate.
- Pressure relief valves on the pump discharge prevent over-pressure of the discharge piping. When activated, the valves direct excess flow to the chemical storage tank(s) through the vent line. Valves control which tank receives the flow.
- Back pressure valves are used to adjust the discharge pressure.
- Pressure switches are used to detect high pressure and shut the pumps down.
- The ultrasonic level sensors monitors the chemical level in the tanks and automatically stops the pumps on low-level and activated an alarm.
- Pump status is output to the DCS.
- A calibration column is provided for calibration of the pumps. The column is normally filled by gravity when the chemical level in the storage tanks is high enough. If the chemical level in both tanks is low, the calibration column can be filled by the pump by opening and closing valve.
- A water supply line is provided for flushing of the pump. Flushing water is fed to the pumps by opening valve. Valves can also be used for draining of the suction lines, but requires opening of valve.
- The pump discharges are interconnected; flow can be directed as desired via of valves.
- Pumps are drained via valves.

.3 Sodium Hydroxide Chemical Metering Pumps

- At initial start-up the pumps require priming. If the duty tank is full, priming occurs naturally due to the head. If the duty tank level is low, and the standby tank is full, valve is opened to provide priming head to the pumps. If the piping to the pump skid contains fluid, priming of the pumps is not necessary, irrespective of the tank levels.
- In normal operation the COH switch is in the COMPUTER position, and the pump speed is controlled from the DCS/PCS.
- Local speed control can be undertaken with the COH switch in the HAND position.
- The three pumps transfer the ferric chloride to the three injection points, as appropriate. It is likely that, under most conditions, only one or two pumps operate.
- Pressure relief valves on the pump discharge prevent over-pressure of the discharge piping. When activated, the valves direct excess flow to the chemical storage tank(s) through the vent line. Valves control which tank receives the flow.
- Back pressure valves are used to adjust the discharge pressure.
- Pressure switches are used to detect high pressure and shut the pumps down.
- The ultrasonic level sensors monitors the chemical level in the tanks and automatically stops the pumps on low-level and activated an alarm.
- Pump status is output to the DCS.
- A calibration column is provided for calibration of the pumps. The column is normally filled by gravity when the chemical level in the storage tanks

is high enough. If the chemical level in both tanks is low, the calibration column can be filled by the pump by opening closing valve.

- A water supply line is provided for flushing of the pump. Flushing water is fed to the pumps by opening valves. Valves can also be used for draining of the suction lines.
- The pump discharges are interconnected; flow can be directed as desired via of valves.
- Pumps are drained via valves.

.6 Chemical Drainage Operation

.1 Ferric Chloride Chemical Sump Pumps
- Drainage
- Vactor Truck

.2 Sodium Hydroxide Chemical Sump Pumps
- Drainage
- Vactor Truck

1.5 BUILDING MECHANICAL SEQUENCE OF OPERATION

.1 Sequence of Operations – Railcar Shelter:

.1 **Radiant Heaters:**

.1 The radiant heaters in the Railcar Shelter shall be each controlled by a thermostat as indicated to maintain space temperature at setpoint. The setpoint shall be operator adjustable. (Set thermostat to 5

.2 The makeup air unit and exhaust fan to be interlocked with each other and to be controlled as follows:

.1 The makeup air unit and exhaust fan to run continuously at its maximum indicated airflow rate. In Unoccupied Mode, the makeup air unit to run continuously at its minimum indicated airflow rate. The makeup air unit is to operate in Occupied Mode when the main lighting for the Chemical Storage Building is on and in Unoccupied Mode when the main lighting for the Chemical Storage Building is off.

~~.1~~.2 For Ferric Chloride Chemical Storage Room, t~~T~~he exhaust fan is ~~to modulate~~ to maintain a negative pressure of 25 Pa in the Chemical Storage Building. (Not applicable to Sodium Hydroxide Chemical Building)~~-~~

~~.2~~.3 In heating mode, the burner section to cycle and modulate as required to maintain a supply air temperature of 10°C.

~~.3~~.4 In cooling mode, the makeup air unit and exhaust fan are energized, and heating is disabled. ~~and modulate to maintain the space at setpoint (27°C).~~

.3 The glycol heat recovery system to be activated via its recirculation pump when the outdoor air temperature is 5°C or less (Operator Adjustable). The three-way valve will modulate the supply glycol temperature to the exhaust coil to be maintain at or above frost protection set point (Operator Adjustable – Initially set). The glycol heat recovery system to be deactivated when the outdoor air temperature is above the heat recovery system activation setpoint.

.1 Monitor glycol supply and return temperatures at each heat recovery coil.

.2 Monitor outdoor air temperatures before and after the supply air coil.

.3 Monitor exhaust air temperatures before and after the exhaust air coil.

.4 Monitor recirculation pump status; alarm pump failures.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.2 Process and HVAC instrumentation.

1.2 REFERENCES

.1 National Electrical Manufacturers Association (NEMA)

.1 NEMA 250-2003, Enclosures for Electrical Equipment (1000 Volts Maximum).

.2 Canadian Standards Association (CSA International).

.1 CSA-C22.1-2009, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

1.3 SUBMITTALS

.1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 01 00 00 – General Provisions, Section 1.28.

.2 Manufacturer's Instructions:

.1 Include manufacturer's installation instructions for specified equipment and devices in O&M Manuals. Part 2 Products

Part 2 Products

2.1 GENERAL

.1 Control devices of each category to be of same type and manufacturer.

.2 External trim materials to be corrosion resistant.

.3 Operating conditions: 0 – 35 degrees C with 5 - 95% RH (non-condensing) unless otherwise specified.

.4 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.

2.2 FLOAT SWITCHES

.1 Requirements:

.1 Suspended mechanical float switch
.2 Fluid: Ferric Chloride and Sodium Hydroxide
.3 Temperature Range: 0 to 50°C
.4 Output: Form C dry contact
.5 Protection: IP68
.6 Approvals: CSA

.2 Acceptable products:

.1 Flygt ENM-10
.2 Or approved equal in accordance with B6.

2.3 FLOW SWITCHES

.1 Requirements:

.1 Thermal Dispersion
.2 Fluid: Water
.3 Temperature Range: -46 to 177 Deg C
.4 Output: SPDT 3A
.5 Power: 24VDC
.6 Enclosure: NEMA4X
.7 Mounting:

.2 Acceptable products:

.1 Or approved equal in accordance with B6.

2.4 AIR PRESSURE SWITCHES

.1 Requirements:

.1 Diaphragm
.2 Fluid: Wastewater
.3 Switch Range: 0 TO 60 PSI
.4 Deadband: 0.3 to 1 PSI
.5 Connection Size: 3/8 inch tube
.6 Input: 24 VDC
.7 Output: SPDT Relay
.8 Protection: B4/Hydraulic: NEMA 4X, IP66. B7: NEMA 7/9, IP66
.9 Approvals: UL, CSA, FM, CE, RoHS (NEMA 4). ATEX, CSA, FM, IECEx, UL, RoHS (NEMA 7)

.2 Acceptable products:

.1 Ashcroft B-Series
.2 Or approved equal in accordance with B6.

2.5 Motion Sensor

.1 Requirements:

.1 Motion detector
.2 Input: 24 VDC
.3 Output: SPST Normally Open Relay
.4 Protection: IP66, NEMA 4X
.5 Approvals: cUL listed

.2 Acceptable products:

.1 Hubbell LightOWL LODTRP1
.2 Or approved equal in accordance with B6.

2.6 ROOM TEMPERATURE SENSORS WITH INTEGRAL TRANSMITTERS

.1 Requirements:

.1 RTD's: 100 ohm platinum element with strain minimizing construction, 3 integral anchored lead wires. Coefficient of resistivity: 0.00385 ohms/ohm degrees C.

.2 Mounting: Wall

.3 Transmitter:

.1 Power Supply: loop powered

.2 Output Signal: 4-20 mA, 2-wire

.3 Accuracy: 0.1 degrees C over range of -200 to 850 degrees C.

.4 Stability: 0.2% of max span drift per year.

.5 Transmitter range: -200 °C to 850 °C

.6 Protection: IP67

.7 Approvals:

.4 Acceptable Products:

.1 Siemens Sitrans TH400

Part 3 Execution

3.1 INSTALLATION

.1 Install equipment, components so that manufacturers and CSA labels are visible and legible after commissioning is complete.

.2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.

.3 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.

.4 Electrical:

.1 Complete installation in accordance with Section 26 05 01 - Common Work Results - Electrical.

.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, 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 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 FLOW TRANSMITTERS

.1 Install in a manner to allow easy removal of the transducer and cable assembly for maintenance purposes.

3.4 IDENTIFICATION

.1 Identify field devices with lamacoids. Install in a conspicuous location.

3.5 TESTING AND COMMISSIONING

.1 Calibrate and test field devices for accuracy and performance in accordance with Section 25 80 11 - Automation Commissioning.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.2 Process Control Devices including damper actuators.

1.2 REFERENCES

.1 National Electrical Manufacturer's Association (NEMA).

.1 NEMA 250-2003, Enclosures for Electrical Equipment (1000 Volts Maximum).

.2 Canadian Standards Association (CSA International).

.1 CSA-C22.1-2009, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

1.3 SUBMITTALS

.1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 01 00 00 – General Provisions, Section 1.28.

.2 Manufacturer's Instructions:

.1 Include manufacturer's installation instructions for specified equipment and devices in O&M Manuals.

Part 2 Products

2.1 GENERAL

.1 Control devices of each category to be of same type and manufacturer.

.2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight assembly.

.3 Operating conditions: 0 – 32 degrees C with 5 - 95% RH (non-condensing) unless otherwise specified.

.4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.

.5 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.

.6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.

2.2 ELECTRONIC ON-OFF DAMPER ACTUATORS

.1 Requirements:

.1 Direct mount on-off type.

.2 Spring return type for "fail-safe" in Normally Open or Normally Closed position as indicated.

.3 Torque: 10 Nm (90 lb-in) minimum.

.4 Damper actuator to drive damper from full open to full closed in less than 90 seconds.

.5 Spring return to drive damper from full open to full closed in less than 60 seconds at normal room temperature.

.6 Angle of Rotation: 90° minimum, adjustable with mechanical stops.

.7 Direction of Rotation: Configurable via switch mounted on the actuator.

.8 Shaft Diameter: 1/2” to 1.05” round, centers on 3/4” with insert, 1.05” without insert

.9 Electrical Connection: 0.9 meter (3 ft), 18 AWG, appliance cables with 1/2” conduit connectors.

.10 Overload protection: Electronic throughout 0° to 95° rotation.

.11 Auxiliary Switches: Two SPDT, 3A resistive (0.5A inductive) @ 250 VAC, one set at +10°, one adjustable 10° to 90° adjustable operation between 0 and 95°.

.12 Power requirements: 6.5 VA maximum at 120 VAC, 60Hz.

.13 Operating Temperature: -30 °C to 50 °C.

.14 CSA listing or equivalent.

.15 Operating Temperature: -30 °C to 50 °C.

.16 Housing: NEMA 4 or IP66 or better.

.17 CSA listing or equivalent.

.2 Acceptable Products:

.1 Intake Air Damper Actuator: Belimo NFBUP-S N4 or approved equal in accordance with B6.

.2 Exhaust Air Damper Actuator: Belimo NFBUP-S N4 or approved equal in accordance with B6.

Part 3 Execution

3.1 INSTALLATION

.1 Install equipment, components so that manufacturers and CSA labels are visible and legible after commissioning is complete.

.2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.

.3 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.

.4 Electrical:

.1 Complete installation in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Install communication wiring in conduit or utilizing ACIC cabling.

.3 Provide complete conduit /cable system to link instrumentation and the control panel(s).

.4 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.

.5 Maximum conduit fill not to exceed 40%.

.6 Design drawings do not show conduit layout.

.5 Terminate devices with leads in junction boxes with terminals.

.1 Wire nuts are not permitted.

.2 Protect leads in flexible conduit.

3.2 IDENTIFICATION

.1 Identify devices with lamacoids. Mount in a conspicuous location.

3.3 TESTING AND COMMISSIONING

.1 Calibrate and test control devices for accuracy and performance in accordance with Section 40 80 11 – Automation Commissioning.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 C22.2 No.205-M1983(R2004), Signal Equipment.

.2 International Electrotechnical Commission (IEC)

.1 IEC 61131, Programmable Controllers

1.2 DEFINITIONS

.1 PLC: Programmable Logic Controller

1.3 PLC SYSTEM DESCRIPTION

.1 This PLC will be connected to the NEWPCC PCS via a Modbus TCP connection.

1.4 SYSTEM ARCHITECTURE

.1 Redundant PLC

.1 Local I/O only.

.2 Connected to the following:

.1 Touchscreen HMI via Modbus TCP over Ethernet

.2 PCS via Fibre Optic

1.5 SOFTWARE OWNERSHIP

.1 The City will fully own all PLC programming logic supplied, and may utilize the software provided for any purpose including:

.1 Modification and revision.

.2 Use at other City facilities.

.2 The City may turn the software over to a 3rd party, for use at any City owned facility.

.3 Provide source code for all custom software and function blocks, or any other software logic utilized in the application.

.1 Source code for base function blocks provided by the PLC manufacturer are not required.

1.6 DESIGN REQUIREMENTS

.1 Design and implement a complete operating PLC system.

.2 The design is to be based upon the supplied Functional Requirements Specification.

.1 Utilize the tag naming convention as detailed within the City's Tag Naming Standard Document No. 612620-0014-40ER-0001.

.3 The PLC software design is to be supervised and approved (sealed) by a Professional Engineer licensed to practice in Manitoba.

.4 Do not assume that the Contractor's internal standards or standard programming methodology will be acceptable for this project. No additional payment will be made for assumptions made regarding standard methods utilized by the Contractor.

.5 The Contract Administrator will review the overall design. Make changes as requested by the Contract Administrator.

1.7 SUBMITTALS

.1 Stage 1:

.1 Submit product datasheets

.2 Stage 2:

.1 Submit a PLC design criteria prior to initiating programming which includes:

.1 The general PLC program structure.

.2 The programming languages (ie ladder, function block) to be utilized

.3 A sample section of code.

.4 HMI interface

.5 PCS interface map.

.6 Variable naming methodology.

.3 Stage 3:

.1 Submit a 25% complete submittal, including:

.1 Software logic printout.

.2 The primary purpose of this submittal is to ensure that the methodology being utilized is as per requirements prior to the bulk portion of the work being completed. At this point, copies of code for similar pieces of equipment should not be completed.

.4 Stage 4:

.1 Submit a 99% complete submittal a minimum of 20 Working days prior to the FAT, including:

.1 Complete software logic printout.

.2 HMI interface

.3 SCADA interface map.

1.8 O&M MANUALS

.1 Include the following in the O&M Manuals:

.1 Product datasheets.

.2 Hardware and software user manuals.

.3 Letter stating that the PLC application has been reviewed and approved. The letter is to be signed and sealed by a Professional Engineer licensed to practice in Manitoba.

.4 HMI and PCS interface map.

.5 PLC database listing and logic printout.

.6 CD sleeve with CD containing PLC application program.

Part 2 Products

2.1 PROGRAMMABLE LOGIC CONTROLLER

.1 Suitable product will be a PLC system produced by a major, international industrial automation vendor.

.2 Modularity

.1 The construction of the PLC is to be modular, utilizing separated modules, that are located within or on a common substructure such as a rack or a DIN rail.

.2 Utilize separate modules for power supplies, fans, processor, and I/O.

.3 Each module to visibly indicate relevant module status information.

.4 Common components within the controller system, such as racks or rails, which cannot be removed and replaced on-line to have a minimum of active components.

.5 Keying systems to be utilised to prevent improper module insertion.

.6 Module set-up is to be universal and not rely on the use of removable components such as jumpers or shorting bars, or require permanent changes to module components.

.7 The organisation of the modules to follow consistent design practices.

.3 Self-Tests, Diagnostics and Failure Modes

.1 Integrity of controller hardware and software to be constantly monitored by an intrinsic series of continuously running self-tests and diagnostics.

.2 Immediately report abnormal results as system alarms.

.3 Have predictable failure mode upon an error. At a minimum, faults are to generate a system alarm.

.4 Equipment may have the ability to diagnose degradations to performance that may not yet adversely affect operator functions or be a permanent failure. When such conditions are automatically noted, the system is to journal the event in the Historian and have the capability to report such information selectively, as either a system alarm or a message on the programming workstation.

.4 Physical Size Requirements

.1 The PLC must fit with the control panel dimensions, as shown in the drawings.

.5 Processor:

.1 Physical Size: To fit in rack as per drawings.

.2 I/O Processing Requirements (minimum)

.1 Discrete I/O: 1024 (in rack)

.2 Analog I/O: 256 (in rack)

.3 Integrated Ethernet port, 10/100 Mb

.1 Capable of native Modbus TCP communication

.1 Use of a Modbus TCP communication module with configurable mapping to internal variables is not acceptable.

.4 Internal RAM: 4096 kB

.5 Flash memory card to contain application program

.1 8 MB minimum or as required to contain application program with 25% spare space.

.1 Application program on memory card to contain all program documentation, provided there is space.

.6 Processing power (minimum)

.1 8100 instructions per ms

.7 Display on front including

.1 Running status

.2 Processor error status

.3 I/O fault status

.4 Serial communication activity

.5 Memory card missing or faulty

.6 Activity on the Ethernet Modbus/TCP network

.7 Ethernet Modbus/TCP network status

.8 Ethernet Modbus/TCP data rate (10 or 100 Mbps)

.8 Real-time clock.

.6 Power Supply

.1 Redundancy: Required.

.2 Requirements:

.1 Supply Voltage: 24 VDC

.2 Supply Protecting: Integral fuse or breaker.

.3 Size: As indicated on the drawings.

.4 Output Voltage: As required.

.5 Output Current: As required, with a minimum of 20% spare capacity above rated current draw of all loads. Calculate power supply loads with all points energised and all installed input and output points used or spare carrying a maximum connected load.

.6 Integrated protection against overloads, short circuits, and overvoltages.

.7 Backplane / Rack

.1 Number of slots: as indicated on drawings

.2 Provide protective covers for all unused slots

.8 Input / Output Modules

.1 General

.1 Functionality

.1 Provide physical interface between field signals and the control equipment.

.2 Provide electrical isolation of circuits between the field and the controller.

.3 Perform validity checks of all input values.

.4 Perform input and output conditioning, including square root extraction.

.5 Perform self-diagnostics.

.6 Perform reporting and responding to the controller.

.7 Display an appropriate alarm on the HMI upon an I/O module failure.

.2 I/O Module Installation:

.1 Capable of being removed from or inserted into their rack slot while under power and without disturbing external wiring.

.2 On-line removal and replacement of a failed module will not require personnel to reconfigure system software, alter system wiring or cabling, de-energize the system module, or re-initialize the controller.

.3 Field Wiring

.1 Terminals at the module, or

.2 Multi-pin connector on the module.

.1 Provide corresponding pre-manufactured cable, minimum 1 meter long, with multi-pin connector at one end and loose wires at the other end.

.2 Discrete Input (DI) Modules

.1 Requirements:

.1 Voltage: 24 VDC.

.2 Current sinking.

.3 Minimum channels per module: 32

.4 Meet IEEE C37.90.1 surge withstand capability.

.5 Isolation: Isolated from logic or processor circuitry via optical coupling or other equivalent means.

.6 Indicating LEDs:

.1 Channel status (on/off) for each I/O channel.

.2 Module Error/Fault.

.3 Discrete Output (DO) Modules – 16 Channel

.1 Requirements:

.1 Voltage: 24 VDC.

.2 Current sourcing.

.3 Current capacity: 0 – 0.5A.

.4 Meet IEEE C37.90.1 surge withstand capability.

.5 Protection against current overloads.

.6 Minimum channels per module: 16

.7 Isolation: Isolated from logic or processor circuitry via optical coupling or other equivalent means.

.8 Configurable fail state: Freeze in the present state (fail-last) or turn off (fail-off), upon a controller or Remote I/O communication failure.

.9 Indicating LEDs:

.1 Channel status (on/off) for each I/O channel.

.2 Module Error/Fault.

.4 Analog Input (AI) Modules

.1 Requirements:

.1 Minimum channels per module: 8 channels

.2 Convert analog signals to digital format with a minimum 15 bit analog-to-digital resolution.

.3 Channels individually configurable for 0-20mA current input, 4-20mA current input, 0-10V voltage input, 2-10V voltage input

.4 Acquisition time: 9 ms maximum for all channels.

.5

.1 Ladder Logic (LD)
.2 Function Block Diagram (FBD)
.3 Sequential Function Chart (SFC)
.4 Structured Text (ST)
.5 Instruction List (IL)

.5 System diagnostics/fault status.
.6 Program documentation/cross-reference printout.
.7 Hardware Configuration.
.8 On-line data changes.
.9 Input/output forcing.
.10 Support both on-line and off-line programming.

.3 Program Instruction Set

.1 Minimum requirements:
.1 Math Instructions: add, subtract, multiply, divide, square root; ladder logic programming to provide integer and floating-point math.
.2 Comparison Elements: Less Than, Greater Than, Equal to, Less than or Equal to, Greater than or Equal to, Not Equal, Relational Contacts.
.3 Timer and Counter Elements: Counterup, Countdown, Time up, Time down (with accumulator, preset and time-base sub-elements); time base from .01 sec to hours) counter scale factors from X1 to X1000.
.4 Relay Contact Elements: N.O., N.C., Transition on, Transition off, (positive/negative).
.5 Relay Coil Elements: Standard, Latch, Unlatch.
.6 Control Algorithms: PID

.4 PLC Simulator

.1 Provide software to simulate a PLC on a PC.

.5 Licence:

.1 Requirements
.1 One user.
.2 Fully capable of programming all features for PLC supplied.
.3 Licence does not expire.

.6 Acceptable Products:

.1 Schneider Electric Unity Pro Small (Latest version available.)

2.3 ACCESSORIES

.1 Include the following accessories:

.1 One Flash card, installed in the PLC processor, for running the application program.
.2 One spare Flash card, of the same size and configuration as that utilized in the processor.
.3 Serial or USB Transfer cable for downloading program.

2.4 USB MEMORY STICK

.1 Provide a USB memory stick as part of the Commissioning process, with the following:

.1 Latest application program, with documentation.
.2 PLC hardware user manuals
.3 PLC software user manuals.
.4 HMI hardware user manuals.
.5 HMI software user manuals.

.2 Locate the memory stick in a pocket in the control panel.

2.5 SPARE PARTS

.1 Supply the following spare parts:

.1 One power supply module.
.2 One backplane.
.3 One processor module.
.4 One DI 24 VDC I/O module.
.5 One DO 24 VDC I/O module.
.6 One AI module.
.7 One AO module.

.2 Complete set of spare parts to be supplied prior to commissioning.

Part 3 Execution

3.1 HARDWARE INSTALLATION

.1 Install the PLC in control Panel CP-Z800 as per manufacturer instructions and recommendations.

.2 Update the processor and all updatable modules with the latest firmware.

3.2 PLC PROGRAMMING SERVICES

.1 General Requirements:

.1 Program in a manner to make the program easy to follow and maintain.
.2 Insert comments into the program to clarify all items not readily apparent.
.3 Utilize commonly accepted good programming practices.
.4 Utilize function blocks to encapsulate common systems and sections of code.
.5 All field inputs to be checked against range limits. If a field input is outside of its range limits or the data cannot be otherwise propagated because of an equipment fault, the data is to be declared "bad" within the Control System.
.6 All tagnames are to be named and identified using positive logic. Where required, provide comments to clarify the states.
.7 Program PID Control loops to provide bumpless transfer when switching between automatic and manual control modes.
.8 Configure alarms generated in the PLC into two types:

.1 Automatic reset alarms clear upon the alarm condition being removed. Provide logic as required to ensure that fast cycling of the alarm does not occur.

.2 Manual reset alarms require reset from the HMI. Utilize manual reset alarms where the initiating condition would be removed by the action resulting from the alarm. Ensure that manual reset alarms are configured such that a reset signal from the HMI will not clear the alarm, unless the initiating condition is cleared.

.9 For any piece of equipment that has control from the PLC, provide a Manual and Auto control mode selector buttons on the equipment faceplate, and allow for manual control of the equipment from the HMI. Provision of a hardwired local, hand, or manual control mode in the field does not eliminate this requirement.

.2 Provide all required PLC programming as per the Functional Requirements Specification.

3.3 PLC COMMISSIONING SERVICES

.1 Provide all required PLC commissioning services as per Section 40 80 11.

.2 Upon completion of commissioning, load latest software onto spare card in spare processor. Test spare prior to turning over to City.

END OF SECTION

Part 1 General

1.1 GENERAL REQUIREMENTS

.1 All Control Panels shall be built by a CSA/cUL-approved manufacturer and shall bear the CSA/cUL seal with the manufacturer's file number.

.2 All Control Panels shall be factory assembled and pre-wired. The Control Panel wiring shall be verified at the manufacturer's factory and completely tested before being shipped to the site.

.3 Supply, install, wire and test all components inside the Control Panels according to the specifications herein and the drawings.

1.2 RELATED SECTIONS

.1 Section 26 05 01 - Common Work Results - Electrical.

.2 Part A to E, and relevant sections of Appendices A to G of these specifications shall apply.

.3 The City of Winnipeg Wastewater Treatment Facilities Automation Design Guide Document Code 612620-0012-40ER-0011 Revision 00

.4 The City of Winnipeg HMI Layout and Animation Plan Revision 01

.5 The City of Winnipeg Identification Standard Revision 02

.6 The City of Winnipeg Tag Naming Standard Document Code: 612620-0014-40ER-0001 Revision 00

1.3 SUBMITTALS

.1 Prior to construction:

- .1 Submit product datasheets, and wait for approval, prior to construction of the Control Panels.
- .2 Submit stamped red-line mark-ups of the proposed modifications to the control panels. If significant modifications are proposed/required, AutoCAD drawings will be supplied to the Contractor for revision.

.2 Prior to shipment:

- .1 Submit electronic pictures of enclosure exterior and interior, including door interior.
  - .1 Pictures to be of sufficient resolution to read component labels.
- .2 As-built drawings:
  - .1 Submit as-built drawings. Minor changes may be made via red-line mark-ups.
  - .2 Draft significant changes on AutoCAD drawings.
- .3 Do not ship control panel until approval from Contract Administrator is received.

1.4 INSPECTION

.1 A factory inspection of the control panels will be performed at the discretion of the Contract Administrator based upon the pre-shipment submittals.

.2 If requested, demonstrate and test the control panel in presence of the Contract Administrator designated representative.

1.5 DESCRIPTION OF WORK INCLUDED

.1 Work of this Section consist of the supply and installation of a complete functional control and instrumentation system.

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

.3 Programmable Logic Controller (PLC), Human Machine Interface (HMI) and other control.

.4 Control panel construction, operator devices and indications.

.5 New system to be integrated in the City's main PCS. Provide programming and process control configuration of the PLC and provision of program documentation.

.6 Contractor to develop the HMI screen of the new system and coordinate with the city to which existing HMI to load it on. Provide commissioning of the new developed HMI screen.

.7 Coordination of controls to work with equipment in the Contract, equipment supplied by Owner, equipment supplied by others, equipment supplied by other trades or under other sections of the Contract.

.8 Training for plant operators as specified herein.

.9 A report generation and editor software package.

.10 Provide redundant OM3 fibre optic cable between remote dosing remote I/O panel LCP-G8000-3 and existing fibre patch panel in Secondary Clarifier control room.

.11 Provide redundant OM3 fibre optic cable between remote dosing remote I/O panel LCP-Y8000-4 and existing fibre patch panel in Secondary Clarifier control room.

.12 Provide LC fibre connectors.

Part 2 Products

2.1 GENERAL

.1 Construction of the control panels is required, in accordance with the supplied drawings.

.2 Control devices of each category shall be of same type and manufacturer.

2.2 ENCLOSURES

.1 Install lamacoids as per the control panel layout drawings.

.2 All indoor control panels shall be NEMA 12 or as shown on drawings.

.3 All enclosure angles and cut-outs shall be free of dents, gouges or weld marks, and shall present a clean, smooth appearance.

.4 No screws, fittings or other fastenings shall be used on external panel faces, which must be free of any marks, scratches or defaults.

.5 The door is to be a minimum fourteen (14) gauge steel plate, full height and flush with adjacent surfaces.

.6 The exterior of the control panel shall be painted ANSI 61 grey.

.7 The interior of the control panel shall be painted gloss white.

.8 Component mounting plates shall be three (3) mm thick steel and shall be painted with one (1) coat of primer and one (1) coat of white baked enamel.

.9 All control panel doors shall be 900 mm (36 inches) wide maximum.

.10 All control panel doors shall open through 180 degrees without restriction.

.11 All control panels of a depth greater than or equal to twelve (12) inches shall be equipped with a fluorescent lighting device located in the cabinet's upper portion with a door switch. Whenever the door is opened, the lighting system shall automatically be activated.

.12 All floor-mounted control panels shall be equipped with lifting eyes that are attached to a structural member that is capable of bearing the control panel load.

.13 Enclosure brand shall be Hoffman or an approved equivalent.

2.3 POWER SOURCE

.1 Each power source must be protected by a CSA approved circuit breaker or fuse.

.2 The location of each power source must be clearly shown.

.3 Panels powered by more than 1 electrical source shall display on their door; "Caution: This panel is electrically powered by more than one source".

2.4 COMPONENTS

.1 Unless written approval for use of unapproved components is received from the owner, all electrical materials (e.g., conduit, fittings, wireways, etc.) shall be CSA or cUL approved.

.2 Rails (DIN Rails)

.1 Rails used must be DIN Rail style TS 35mm, slotted.

.2 When used to mount terminals, rails shall be mounted on straight raisers (Rail support / Mounting feet) so as to raise them to the same height as the highest adjacent wiring duct.

.3 Raisers (Rail support / Mounting feet) shall not be used when rail hosts heavy components.

.3 Terminals

.1 Requirements:

.1 TS-35 DIN Rail mounting.

.2 Voltage rating:

.1 600V for general control circuits.

.2 600V for power circuits.

.3 Manufacturer: Phoenix Contact or approved equal in accordance with B6.

.2 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.

.3 Each terminal shall bear an identification number on both sides.

.4 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.

.4 Ground Bus Bar

.1 Supply a ground bus bar in each control panel.

.2 Requirements:

.1 Tapped holes with screws.

.2 Bar to have sufficient connection points for all cables entering the control panel, plus 25% spare.

.3 Maximum one wire termination per screw.

.5 Pushbutton, Switch and Indicator Light

.1 When required, all control panel pushbuttons, switches and indicator lights shall be at least NEMA 12 (or better)-type devices.

.2 Manufacturer to be Allen-Bradley or approved equivalent.

.6 Programmable Logic Controllers

.1 As per section 40 94 43.

.7 Touch-screen HMI

.1 As per section 40 95 20.

.8 General Purpose Relays

.1 Type: DPDT or as shown on drawings

.2 Indication: LED

.3 Coil Voltage: As per drawings

.4 Contact Rating: 5A (120 VAC), 5A (24 VDC)

.5 Approvals: CSA

.6 Manufacturer: Omron or approved equal in accordance with B6

.9 24 VDC Power Supplies

.1 Size: As shown on the drawings
.2 Supply Voltage: 120 VAC, 1ph
.3 Approvals: CSA
.4 Manufacturer: Sola or approved equal in accordance with B6

.10 Uninterruptible Power Supply

.1 Size: As per drawing VA
.2 Input Voltage: 24 VDC
.3 Output Voltage: 24 VDC
.4 Battery: DIN Rail Mount
.5 Monitoring Contacts: Battery Fault, Low Battery (Form C SPDT)
.6 Manufacturer: Sola or approved equal in accordance with B6

.11 Control Network Ethernet Switch:

.1 Support Modbus\TCP Industrial Ethernet protocol
.2 Support Turbo Ring, Turbo Chain, and RSTP/STP (IEEE 802.1w/D) for network redundancy.
.3 Contain a minimum of eight (8) 10/100/1000BaseT(X) ports plus four (4) 100/1000 Base SFP fiber optic port.
.4 Contain 1 relay outputs alarm contacts rated 1 A at 24 Vdc.
.5 Switch shall be DIN-Rail mountable.
.6 Switch shall be designed for industrial networks usage.
.7 Approved Product: Moxa EDS-G512-4GSFP Series switch

.12 Device Network Ethernet Switch:

.1 As per drawings
.2 Input Voltage: 24 VDC
.3 Monitoring Contacts: Power Supply Fault, Communications Port Fault
.4 Ports:
.1 Eight x 10BASE-T/100BASE-TX ports, RJ 45 connectors
.5 Manufacturer: Schneider Electric

.13 Grounding

.1 All control panel components shall be adequately grounded in accordance with the component manufacturer, especially control system components.
.2 Firmly bond all panel mounted devices on or within the panels to ground. Provide supplementary bonding conductors for back panels and doors. Attach a separate bonding conductor to all devices that are not firmly fastened to the panels with screws for such devices as case mounted instruments, meters, etc.
.3 Where ground bars are installed on to the rear or side wall of the enclosure, seal screw penetrations to maintain enclosure rating.

.14 Wiring

.1 Panel wiring shall be installed in a near and orderly manner.
.2 All conductors shall be securely fastened to terminals at both ends; no splices are allowed inside the panel.

.3 No more than two (2) conductors may be terminated under each terminal screw. All internal panel conductors shall be connected to the same side of a terminal block, and external conductors to the other side. The only exception is for fused terminals which require connection to the field side for internal wiring.

.4 All wires and cables inside the control panels shall be identified on both ends with non-erasable markers.

.5 Identification shall follow the supplied documents, such as wiring diagrams.

.1 Label both ends of each wire.

.2 Utilize machine printed non-slip labels. Wrap-around or self-adhesive markers shall not be permitted.

.3 Wherever possible wire labels shall be positioned to be read from the panel opening without removal of wire duct covers or other wiring.

.6 Individual conductors or wires exiting a cable shall be identified using nonerasable markers.

.7 The routing of all analog, digital, and power cable wiring inside control panels shall be segregated as much as possible, in distinct wiring ducts, by the type of signal they are carrying. All wires shall be physically protected by wiring ducts with covers. The wiring ducts shall be of sufficient size to be filled to a maximum of 50% when all wires are inside.

.8 All analog signal wiring shall be 18 AWG shielded twisted pairs such as Belden No. 8760, or an approved equivalent. Shield wires exiting the jacket must be covered with a black heat shrink, and the overall cable at the jacket end must also be covered with a heat shrink.

.9 All 24 VDC or 120 VAC discrete signal panel wiring shall be 16 AWG TEW stranded conductor.

.1 Increase the size of power wiring, 12 AWG minimum.

.10 The sizes and colours of wires shall be in accordance with the CSA and the Canadian Electrical Code.

.11 The panel builder shall group and form wiring into a loop when going from a fixed part of the panel to a door such that there is sufficient slack to minimize strand fatigue and breaking. Each end of the loop shall be properly supported.

.12 Ethernet Patch Cords

.1 Requirements:

.1 Cat-6A.

.2 Jacket colour: Blue.

.13 Wiring Duct

.1 All wires shall be run in narrow slot wiring duct such as such as Panduit or an approved equivalent.

.2 Wiring Duct shall be installed on both sides of the panel and between the DIN rails.

.3 Wire or cable, connected to internal device or arriving from external device, shall be uncovered by Wiring Duct for a maximum of 10 cm.

.4 120 VAC wires cannot share wiring duct with 10 VDC, 24 VDC or 4-20 mA wires, but can cross their path.

.5 All DC, AC, and thermocouple wiring shall be routed in separate wireways to prevent signal interference.

.14 Wire ties shall be non-metallic.

.15 Wiring shall be arranged to be readily accessible for inspection and maintenance.

.16 The wiring arrangement shall not interfere with access to panel-mounted devices or spaces for future equipment.

.15 Overcurrent Protection

.1 Panel-mounted devices and all control circuits shall be protected by appropriately sized fuses or circuit breakers.

.16 Internal Lighting

.1 Difficulties resulting from electrical noise generated by fluorescent lamps shall be corrected.

.17 Cooling and Heating Systems

.1 Control panels shall be designed for the environmental conditions of the installation location. Cooling and heating systems shall be in accordance with the specific NEMA rating required by NEMA ICS 6 and NEMA 250.

Part 3 Execution

3.1 COMPONENT INSTALLATION

.1 Components on the front of the panel shall be identified with an individual permanent nameplate installed in an organized manner. The nameplate must identify the component's function.

.2 Each component inside the control panel shall be identified with a nameplate corresponding to the drawings.

.3 All non-DIN rail mountable devices in the control panel shall be mechanically affixed to the back panel with either tapped or self-tapping screws.

.4 All control devices shall be mounted so that any component can be replaced without removing the sub-panel or other components.

.5 Components and/or auxiliary instruments mounted at the rear of the panel shall be readily accessible and their installation shall not be affected by, or interfere with the removal of any panel instrument.

.6 Nameplates shall be made of lamacoid material with a white background and engraved black letters for internal and external components. Nameplates must resist harsh industrial conditions.

.7 Supply and install all required fuses.

.8 Control devices must be spaced adequately to allow for cooling, replacement, servicing, and wiring access.

.9 Control devices shall be grouped according to voltage and function to reduce electrical noise.

.10 Cutouts for instruments shall be within the tolerances specified by the instrument manufacturer.

.11 If cutouts are specified for future instruments, the cutouts shall be covered by removable steel plates 3 mm (1/8 inch) thick. The cover plates shall be finished and painted with the same paint as applied to the front panel.

.12 If any panel-mounted item is not available for installation before the panel is scheduled for shipment, wiring from the terminal block to the panel location for the item shall be completed, wire ends shall be formed exactly to the configurations required, and identifying sleeves shall be applied, ready for connection.

.13 Panel areas designated for future equipment shall be kept clear of stiffening members, rear-mounted equipment, wiring, and all other interferences.

.14 Ample space shall be provided for the entrance of external cables into the panel and for routing the cables to terminating points within the panel.

3.2 IDENTIFICATION

.1 Perform terminal identification using a computerized device. Handwriting is not acceptable.

.2 Label terminals as shown on drawings.

.3 Install label above each terminal block with terminal block name.

3.3 TESTING

.1 Testing of the control panels shall be completed to the greatest extent possible prior to the FAT, and shall include at minimum:

- .1 Provide a signed and dated inspection sheet with all tests performed listed on it.
- .2 The list of the various test procedures described hereunder is not restrictive, and does not relieve the control panel manufacturer of his responsibility to perform any other work that is not mentioned but requested to verify the good operation of the control panels.
- .3 Isolate all instruments and components of the control panels as required to protect them from any damage during tests.
- .4 Provide the services of qualified personnel as well as tools and equipment required to perform all tests and inspection of the control panels.
- .5 Tests to include:
  - .1 Power supply functionality
  - .2 PLC component functionality
  - .3 Point to point tests of all inputs and outputs
  - .4 Power terminal voltage verification
  - .5 Relays and switches functionality
  - .6 E-stop system component functionality
  - .7 Receptacle and lighting functionality
  - .8 Ethernet switch and fibre transceiver functionality
- .6 If the panel is modified after tests have been performed, tests shall be repeated.

3.4 SHIPMENT

.1 If any panel-mounted item is not available for installation before the panel is scheduled for shipment, wiring from the terminal block to the panel location for the item shall be

completed, wire ends shall be formed exactly to the configurations required, and identifying sleeves shall be applied, ready for connection.

.2 Shipment of any panel having shortages of equipment shall be approved in writing by the owner.

3.5 SPARE COMPONENTS

.1 Supply two spares of each fuse type and rating. Place in a clear plastic bag and attach to the panel door interior

END OF SECTION

Part 1 General

1.1 SUBMITTALS

.1 Submit product data.

Part 2 Products

2.1 GENERAL

.1 Unless otherwise specified, provide outside finishes on all enclosures in ANSI 61 Grey.

.2 The enclosures must be suitable for carrying the weight of the equipment mounted inside the panel and on the doors without any warpage.

.3 Provide a lamacoid for the junction box with identifier.

.4 Provide a lamacoid for the junction box with power panel and circuit number, if applicable.

2.2 ENCLOSURES

.1 Enclosures shall be NEMA 4 rated unless located in electrical.

.2 Enclosures in Category 2 or Category 2 Wet locations shall be stainless steel for Sodium Hydroxide building, Piping Galleries and Junction Chamber.

.3 Enclosures in Category 2 or Category 2 Wet locations shall be Fibreglass in Ferric Chloride building.

.4 Enclosures shall have a continuous hinge with clamps for closing.

.5 Manufacturer: Hoffman or approved equal in accordance with B6.

2.3 WIRING AND ACCESSORIES

.1 Provide wiring inside the panels according to the following Specifications:

.1 Control wiring to be a minimum of 16 AWG tinned stranded copper; insulation rated at 600 V.

.2 Wiring for power distribution shall be a minimum of 14 AWG tinned stranded copper; insulation rated at 600 V.

.3 Install cables in accordance with the requirements of Division 26.

.2 Tag each wire at both ends with a heat shrink sleeve that is machine printed. Allow approximately 20 mm of wire insulation between the tag and the bare wire.

.3 Wiring systems with different voltage levels or types shall be suitably segregated within the panel, according to relevant electrical codes.

.4 Run all wiring in enclosed plastic wireways such as Panduit. Size all wireways so that the total cross-sectional area of the insulated wire and cable does not exceed 40 percent of the cross-sectional area of the wire way.

.5 Provide a minimum clearance of 50 mm between wire ways and any point of wire termination.

.6 Terminate all wiring, incoming and outgoing, at terminal strips mounted inside the panels. Identify each terminal strip with a terminal strip number, as per the drawings.

.7 Provide sufficient terminals so that not more than two wires are connected under the same terminal.

.8 Provide nameplates for each device on or within the enclosure.

2.4 PANEL GROUNDING

.1 Firmly bond all panel-mounted devices on or within the panels to ground. Provide supplementary bonding conductors for backpanels and doors. Attach a separate bonding conductor to all devices that are not firmly fastened to the panels with screws for such devices as case mounted instruments, meters, etc.

Part 3 Execution

3.1 MOUNTING HEIGHTS

.1 Unless otherwise specified or a conflict exists, mount all panels, starters and disconnects 2000 mm to top of cover.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Provide training per this section and Section 01 79 00.

1.2 SUBMITTALS

.1 Submit training proposal a minimum of 30 working days prior to anticipated date of beginning of training.

.1 Name and qualifications of trainer. Identify how the trainer will be familiar with the project, and training qualifications and experience.

.2 List type of visual and audio aids to be used, including simulation equipment.

.3 Hour-by-hour schedule including brief overview of content.

.4 Copy of training manual.

1.3 QUALITY ASSURANCE

.1 Provide competent instructor(s) thoroughly familiar with all aspects of the instrumentation system installed in the facility.

.2 Instructor to have qualifications, acceptable to the Contract Administrator, regarding training. Expectations will be completion of a certified training course, and/or demonstrated experience, proficiency, and quality of training.

.3 Contract Administrator reserves right to approve instructors.

1.4 INSTRUCTION

.1 Provide instruction to designated personnel in adjustment, operation, maintenance and pertinent safety requirements of the system installed.

1.5 TRAINING MATERIALS

.1 Provide equipment, visual and audio aids, and materials for classroom training at City's site.

.2 Supply manual for each trainee, describing in detail data included in the training program.

.1 Review contents of manual in detail to explain aspects of operation and maintenance (O&M).

.3 Setup an operating simulation of the HMI software, projected onto a screen. The controller (may be spare) and simulation software is to be utilized to provide a seamless simulation and demonstration system.

1.6 TRAINING PROGRAM

.1 Operations Training

.1 Location: At a facility provided by the City.

.2 Duration: Four hours.

.3 Number of Sessions: Two (on separate days)

.4 Number of trainees: Coordinate with Contract Administrator prior to training.

.5 Audience: Operations and maintenance personnel.

.1 Content:

.2 General system overview.

.3 Description of system components.

.4 Presentation of the HMI and system operation.

.1 Use of the system.

.2 Navigation.

.3 Alarm system use.

.5 Manual control via motor starters, and control panels. (Provide drawings / photos of control panels in manuals and via PowerPoint presentation)

1.7 MONITORING OF TRAINING

.1 Contract Administrator to monitor training program and may modify schedule and content.

.2 In the event that the Contract Administrator or City are unsatisfied with the training, make changes to the training program as required and repeat the training.

Part 2 PRODUCTS

2.1 GENERAL

.1 Not Applicable.

Part 3 EXECUTION

3.1 TRAINING

.1 Provide on-site training to City personnel, as indicated above.

END OF SECTION

Part 1 General

1.1 MAINTENANCE SERVICES

.1 Not required.

1.2 SUPPORT SERVICES

.1 Duration:

.1 The duration of support services is to extend during the Warranty period (one 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 critical system supplied by the Vendor.

.2 Critical systems include, but are not limited to:

.1 Communication networks.

.2 PLC system.

.3 HMI systems.

.3 Perform work continuously until system is restored to a reliable operating condition.

.4 Response Time:

.5 The response time to emergency service calls is to be less than four hours.

.1 Record each service call request, when received separately on approved form and include:

.2 Serial number identifying component involved.

.3 Location, date and time call received.

.4 Nature of trouble.

.5 Names of personnel assigned.

.6 Instructions of work to be done.

.7 Amount and nature of materials used.

.8 Time and date work started.

.9 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 covered under manufacturer's warranty, the Contractor will be paid for the service call.

.3 If the issue is determined to be due to an issue outside of the Contractor's responsibility, the Contractor will be paid for the service call.

.4 Payment will be based upon the rates specified in Form B.

.5 If the service call is subsequent to Total Performance, submit an invoice, based upon the established rates to the City.

Part 2 Part 2 Products

2.1 NOT APPLICABLE.

.1 Not applicable.

Part 3 Part 3 Execution

3.1 NOT APPLICABLE.

.1 Not applicable.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 This Section covers items common to Sections Division 26, Electrical.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.2 CSA C22.1-06, Canadian Electrical Code, Part 1 (20th Edition), Safety Standard for Electrical Installations.

.3 CAN3-C235-83(R2000), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

.4 SPEC NOTE: Electrical and Electronic Manufacturer's Association of Canada (EEMAC) stopped issuing standards in 1994. Their standards are still available but have not been updated nor are they planning to update them. Almost all products now are manufactured to National Electrical Manufacturers Association (NEMA) standards.

.5 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)

.6 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.

.7 EEMAC Y1-1-1955, Equipment Green Colour for Outdoor Electrical Equipment.

.8 SPEC NOTE: The following reference standard IEEE SP1122, replaces former IEEE Std 100.

.9 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)

.10 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

.11 City of Winnipeg

.12 Identification Standard – 510276-0000-40ER-0002.

.13 Tag Naming Standard – 612620-0014-40ER-0001.

1.3 DEFINITIONS

.1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

1.4 DESIGN REQUIREMENTS

.1 Operating voltages: to CAN3-C235.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.

.1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

.3 Language operating requirements: provide identification nameplates and labels for control items in English.

1.5 SUBMITTALS

.1 Submit for review single line electrical diagrams and locate under plexiglass in electrical rooms.

.2 Shop drawings:

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

.2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.

.3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.

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

.5 Submit copies of 600 x 600 mm minimum size drawings and product data to inspection authorities.

.6 If changes are required, notify Contract Administrator of these changes before they are made.

.3 Quality Control:

.1 Provide CSA certified equipment and material. Where CSA certified equipment and material is not available, submit such equipment and material to inspection authorities for special approval before delivery to site.

.2 Submit test results of installed electrical systems and instrumentation.

.3 Permits and fees: in accordance with General Conditions of contract.

.4 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.

.5 Submit certificate of acceptance from inspection authority upon completion of Work to Contract Administrator.

.4 Manufacturer's Field Reports: submit to Contract Administrator manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

1.6 QUALITY ASSURANCE

.1 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices as per the conditions of Provincial Act respecting manpower vocational training and qualification.

.1 Employees registered in provincial apprentices' program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.

.2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Material Delivery Schedule: provide Contract Administrator with schedule within 2 weeks after award of Contract.

.2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling.

1.8 SYSTEM STARTUP

.1 Instruct Contract Administrator and operating personnel in operation, care and maintenance of systems, system equipment and components.

.2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

1.9 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling.

.2 Collect and separate paper, plastic, polystyrene and corrugated cardboard packaging material for recycling.

.3 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Contract Administrator.

.4 Fold up metal banding, flatten and place in designated area for recycling.

.5 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.6 SPEC NOTE ENVIRONMENT: Since emptied containers retain product residues (vapours, liquids and/or solids) extreme caution should still be exercised in their handling. Keep out of reach of children.

.7 Place materials defined as hazardous or toxic waste in designated containers.

.8 Ensure emptied containers are sealed and stored safely for disposal away from children.

.9 Unused sealant material must not be disposed of into sewer system, streams, lakes, onto ground or in other location where it will pose health or environmental hazard.

.10 Do not dispose of preservative treated wood through incineration.

.11 Do not dispose of preservative treated wood with other materials destined for recycling or reuse.

.12 Dispose of treated wood, end pieces, wood scraps and sawdust at sanitary landfill approved by Contract Administrator.

1.10 OPERATING AND MAINTENANCE MANUALS

.1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.

.2 Operating instructions to include following:

.3 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

.4 Service instructions: Including a list of spare parts and replacement parts and the names and addresses of all suppliers.

.5 Maintenance instructions: Including start-up, proper adjustment, lubrication and shutdown procedures.

.6 Installation instructions.

.7 Operating instructions.

.8 Safety precautions.

.9 Other items of instruction as recommended by manufacturer of each system or item of equipment.

.10 Operating instructions have to be laminated and placed within the station next to its equipment. Operating instructions to be reviewed by Engineer prior to laminating.

.11 Post instructions where directed.

.12 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.

.13 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

Part 2 Products

2.1 MATERIALS AND EQUIPMENT

.1 Provide material and equipment.

.2 Material and equipment to be CSA certified. Where CSA certified material and equipment is not available, obtain special approval from Electrical Inspections Department before delivery to site and submit such approval as described in PART 1 - SUBMITTALS.

.3 Factory assemble control panels and component assemblies.

2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

.1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

.2 Control wiring and conduit: in accordance with Section 26 29 03 - Control Devices except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections and as shown on mechanical drawings.

2.3 WARNING SIGNS

.1 Warning Signs: in accordance with requirements of inspection authorities and Contract Administrator.

.2 Decal signs, minimum size 175 x 250 mm.

2.4 WIRING TERMINATIONS

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

2.5 EQUIPMENT IDENTIFICATION

.1 Identify electrical equipment with nameplates and labels in accordance with Identification Standard – 510276-0000-40ER-0002.

2.6 WIRING IDENTIFICATION

.1 Identify conductors and cables in accordance with Identification Standard – 510276-0000-40ER-0002.

2.7 EQUIPMENT IDENTIFICATION

.1 Identify electrical equipment with nameplates and labels in accordance with Identification Standard – 510276-0000-40ER-0002.

2.8 FINISHES

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

.2 Paint outdoor electrical equipment "equipment green" finish to EEMAC Y1-1.

.3 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1.

2.9 ELECTRICAL SINGLE LINE DIAGRAMS

.1 Provide electrical single line diagrams under plexiglass as follows:

.2 Electrical distribution system: locate in main electrical room

.3 Drawings: 11 X 17 size.

2.10 CONDUIT AND CABLE IDENTIFICATION

.1 Colour code conduits, boxes and metallic sheathed cables.

.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

.3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue
up to 15 kV	Yellow	Red
Telephone	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

2.11 SCOPE OF WORK

.1 The scope of the electrical work includes all items identified on the drawings and the specifications. The following list of major work items has been provided to provide a high-level overview.

.1 Provide a new 600 V 125A-3P breaker to be installed in existing Sludge Dewatering MCC- 1WB, section 8 cell space. Breaker shall be complete with MCC wrapper suitable for a size 1 space. Provide a new MCC door over breaker compartment. Existing equipment is a Westinghouse 5 Star MCC. Breaker shall be of the same manufacture as the existing breakers with the same fault current rating.

.2 Provide a new 600 V 225A-3P breaker to be installed in existing Sludge Dewatering MCC-1WB, section 8 cell space. Breaker shall be complete with MCC wrapper suitable for a size 1 space. Provide a new MCC door over breaker compartment. Existing equipment is a Westinghouse 5 Star MCC. Breaker shall be of the same manufacture as the existing breakers with the same fault current rating.

.3 Provide a new 4C#1/0 AWG from new breaker in MCC, through floor to room below the Sludge Dewatering Electrical Room, through the exterior wall of the Dewatering building and into the new Sodium Hydroxide Chemical Building (102). Connect to main breaker of PNL-W7100. See single line diagram drawing.

.4 Provide a new 4C#4/0 AWG from new breaker MCC, through floor to room below the Sludge Dewatering Electrical Room, through the exterior wall of the Dewatering building and into the new Chemical Building Electrical Roo (101D). Connect to main breaker of PNL-F7000. See single line diagram drawing.

.5 Provide a new 600 V 3 phase 225-amp panel (PNL-F7000), a new 45 kVA transformer (600 V-120/208 V 3 phase 4-wire) and a new 120/208 V 3 phase 4-wire panel in new Chemical Building Electrical room (101D). See single line diagram drawing.

.6 Provide a new 600 V 3 phase 125-amp panel (PNL-W7100), a new 30 kVA transformer (600 V-120/208 V 3 phase 4-wire) and a new 120/208 V 3 phase 4-wire panel in new Sodium Hydroxide Chemical Building (102). See single line diagram drawing.

.7 Provide new FVNR motor starter for 20hp air compressor installed in existing Sludge Dewatering MCC-2WB, section 7 cell space.

.8 Provide all wiring, cable, and conduit for all mechanical equipment for the new Chemical Building 101C, Railcar Shelter 2 (101B) and Sodium Hydroxide building 102.

.9 Provide all lighting, lighting controls, exit lighting, emergency lighting, and general power as specified herein and indicated on the drawings.

.10 Provide all instrumentation and control as specified herein and indicated on the drawings.

.11 Provide new PLC control panels and remote I/o control panel as specified herein and indicated on the drawings

.12 Provide security camera system as specified herein and indicated on the drawings. as specified herein and indicated on the drawings.

.13 Provide card access system as specified herein and indicated on the drawings.

.14 Provide all fire alarm system as specified herein and indicated on the drawings.

.15 Provide disconnects switches at equipment where required.

.16 Provide trenching and backfilling.

.17 Provide VFD control panels for chemical dosing and transfer pumps.

.18 Disconnect and removed existing artificial grounding system and associated rods of existing Sludge Dewatering building drawings and install a new artificial grounding system complete with grounding rods as indicated on site plan. Existing grounding shall be removed when new artificial grounding is in-place.

.19 Provide heat tracing system as specified herein and indicated on the drawings.

Part 3 Execution

3.1 INSTALLATION

.1 Complete installation in accordance with the current edition of the Canadian Electrical Code, CSA C22.1, except where specified otherwise.

.2 Do overhead and underground systems in accordance with the current edition of CSA C22.3 No.1 except where specified otherwise.

.3 Perform all work in accordance with local codes and by-laws.

3.2 NAMEPLATES AND LABELS

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

3.3 CONDUIT AND CABLE INSTALLATION

.1 Install conduit and sleeves prior to pouring of concrete.

.1 Sleeves through concrete: plastic, sized for free passage of conduit, and protruding 50 mm.

.2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

.3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.4 LOCATION OF OUTLETS

.1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.

.2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.

.3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.

.4 Locate light switches on latch side of doors.

.1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

3.5 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation. Install electrical equipment at following heights unless indicated otherwise.

.1 Local switches: 1400 mm.
.2 Wall receptacles:
  .1 General: 300 mm.
  .2 Above top of continuous baseboard heater: 200 mm.
  .3 Above top of counters or counter splash backs: 175 mm.
  .4 In mechanical rooms: 1400 mm.
.3 Panelboards: as required by Code or as indicated.
.4 Telephone and interphone outlets: 300 mm.
.5 Wall mounted telephone and interphone outlets: 1500 mm.
.6 Fire alarm stations: 1500 mm.
.7 Fire alarm bells: 2100 mm.
.8 Television outlets: 300 mm.
.9 Wall mounted speakers: 2100 mm.
.10 Clocks: 2100 mm.
.11 Door bell pushbuttons: 1500 mm.

3.6 CO-ORDINATION OF PROTECTIVE DEVICES

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

3.7 FIELD QUALITY CONTROL

.1 Load Balance:

.1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.3 Provide upon completion of work, load balance report as directed in PART 1 - SUBMITTALS: phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.

.2 Conduct following tests:

.1 Power distribution system including phasing, voltage, grounding and load balancing.

.2 Circuits originating from branch distribution panels.

.3 Lighting and its control.

.4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

.5 Systems: fire alarm system and communications.

.6 Insulation resistance testing:

.1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.

.2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.

.3 Check resistance to ground before energizing.

.3 Carry out tests in presence of Contract Administrator.

.4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.5 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.8 CLEANING

.1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 01 – Common Works Results – For Electrical

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.2 No.18.1-13 (R2018), Metallic outlet boxes (Tri-national standard, with UL 514A and ANCE NMX-J-023/1)

.2 CSA C22.2 No.65-18, Wire Connectors.

.2 City of Winnipeg

.1 Identification Standard – 510276-0000-40ER-0002.

.2 Tag Naming Standard – 612620-0014-40ER-0001.

Part 2 Products

2.1 MATERIALS

.1 Pressure type wire connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.

.2 Fixture type splicing connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

.3 Clamps or connectors for armoured cable as required to: CAN/CSA-C22.2 No.18.

Part 3 Execution

3.1 INSTALLATION

.1 Remove insulation carefully from ends of conductors and:

.1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.

.2 Install fixture type connectors and tighten. Replace insulating cap.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 01 – Common Works Results – For Electrical

.2 Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

.3 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.

.4 Section 01 00 01 – General Provisions.

1.2 REFERENCES

.1 CSA C22.2 No .0.3-09 (R2014), Test Methods for Electrical Wires and Cables.

.2 CAN/CSA-C22.2 No. 131-17, Type TECK 90 Cable.

.3 City of Winnipeg

.1 Identification Standard – 510276-0000-40ER-0002.

.2 Tag Naming Standard – 612620-0014-40ER-0001.

1.3 SHOP DRAWING

.1 Include detail construction, dimension, capacities, weights of equipment or material.

Part 2 Products

2.1 BUILDING WIRES

.1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.

.2 Copper conductors: size as indicated, with 1000 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90.

2.2 1 KV TECK90 POWER CABLE

.1 Cable: to CAN/CSA-C22.2 No. 131.

.2 Conductors:

.1 Grounding conductor: copper.

.2 Circuit conductors: copper, size as indicated. (12 AWG minimum where not indicated)

.3 Insulation:

.1 Type: ethylene propylene rubber.

.2 Chemically cross-linked thermosetting polyethylene rated type RW90, 1000 V.

.4 Inner jacket: polyvinyl chloride material.

.5 Armour: interlocking aluminum.

.6 Overall covering: thermoplastic polyvinyl chloride material.

.7 Fastenings:

.1 One hole steel straps to secure surface cables 50 mm and smaller. Two-hole steel straps for cables larger than 50 mm.

.2 Channel type supports for two or more cables at 300 mm centers.

.3 Threaded rods: 6 mm dia. to support suspended channels.

.8 Connectors:

.1 Watertight, explosion-proof approved for TECK cable.

2.3 600 V TECK90 CONTROL CABLE

.1 Cable: to CAN/CSA-C22.2 No. 131.

.2 Conductors:

.1 Grounding conductor: copper.

.2 Circuit conductors: copper, size as indicated. (14 AWG minimum where not indicated)

.3 Insulation:

.1 Type: ethylene propylene rubber.

.2 Chemically cross-linked thermosetting polyethylene rated type RW90, 600 V.

.4 Inner jacket: polyvinyl chloride material.

.5 Armour: interlocking aluminum.

.6 Overall covering: thermoplastic polyvinyl chloride material.

.7 Fastenings:

.1 One hole steel straps to secure surface cables 50 mm and smaller. Two-hole steel straps for cables larger than 50 mm.

.2 Channel type supports for two or more cables at 300 mm centers.

.3 Threaded rods: 6 mm dia. to support suspended channels.

.8 Connectors:

.1 Watertight, explosion-proof approved for TECK cable.

2.4 300 V INSTRUMENT CABLE

.1 Conductors: 16 AWG, 7 strand concentric lay, Class B tinned copper, twisted pairs/triads.

.2 Insulation: PVC TW75, 75 °C Wet, 105 °C Dry (-40 °C), 300 Volt.

.3 Twisted pairs/triads cabled with staggered lays.

.4 Shielding: Individual twisted pair(s)/triads Aluminum/mylar shield with ST drain wire, 100 % shield. Overall aluminum/mylar shield with ST drain wire. Individual drain wires one size smaller than conductor AWG. Overall drain wire the same AWG as conductors.

.5 Armour: interlocking aluminum.

.6 Overall covering: thermoplastic polyvinyl chloride material (90 °C, -40 °C).

.7 Fastenings:

.1 One hole steel straps to secure surface cables 50 mm and smaller. Two-hole steel straps for cables larger than 50 mm.

.2 Channel type supports for two or more cables at 300 mm centers. .

.8 Connectors:

.1 Watertight, explosion proof approved for armoured cable.

2.5 TYPE RW90 CONDCUTOR

.1 In accordance with CSA C22.2 No.38

.2 Circuit conductors shall be concentric stranded soft copper, size as indicated (12 AWG minimum where not indicated).

.3 Insulation to be chemically cross-linked thermosetting polyethylene rated type RW90 XLPE, 600V

.4 Suitable for installation in temperatures down to -40 °C.

.5 90 °C conductor operating temperature.

2.6 WIRING IDENTIFICATION

.1 Provide wiring identification in accordance with Section 26 05 01 – Common Work Results – For Electrical

Part 3 Execution

3.1 INSTALLATION OF BUILDING WIRES

.1 Install wiring as follows:

.2 In conduit systems in accordance with Section 26 05 34 – Conduits, Conduit and Conduit Fittings.

3.2 INSTALLATION OF TECK CABLE 0 -1000 V

.1 Install cables.

.1 Group cables wherever possible on channels.

.2 Terminate cables in accordance with Section 26 05 20 – Wire and Box Connectors - 0 -1000 V.

3.3 INSTALLATION OF ARMOURED CABLES

.1 Group cables wherever possible.

.2 Terminate cables in accordance with Section 26 05 20 – Wire and Box Connectors - 0 -1000 V.

3.4 INSTALLATION OF CONTROL CABLES

.1 Install control cables in conduit.

.2 Ground control cable shield.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association, (CSA)

.2 Insulated Cable Engineers Association, Inc. (ICEA)

Part 2 Products

2.1 CABLE PROTECTION

.1 38 x 140 mm planks pressure treated water repellent preservative.

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 Wooden post type markers: 89 x 89 mm, 1.5 m long, pressure treated with water repellent 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.

Part 3 Execution

3.1 DIRECT BURIAL OF CABLES

.1 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.

.2 Make termination and splice only as indicated leaving 0.6 m of surplus cable in each direction.

.1 Make splices and terminations in accordance with manufacturer's instructions using approved splicing kits.

.3 Underground cable splices not acceptable.

.4 Minimum permitted radius at cable bends for rubber, plastic or lead covered cables, 8 times diameter of cable; for metallic armoured cables, 12 times diameter of cables or in accordance with manufacturer's instructions.

.5 Cable separation:

.1 Maintain 75 mm minimum separation between cables of different circuits.

.2 Maintain 300 mm horizontal separation between low and high voltage cables.

.3 When low voltage cables cross high voltage cables maintain 300 mm vertical separation with low voltage cables in upper position.

.4 At crossover, maintain 75 mm minimum vertical separation between low voltage cables and 150 mm between 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 Install treated planks on lower cables 0.6 m in each direction at crossings.

.6 After sand protective cover is in place, install continuous row of overlapping 38 x 140 mm pressure treated planks as indicated to cover length of run.

3.2 CABLE INSTALLATION IN DUCTS

.1 Install cables as indicated in ducts.

.2 Do not pull spliced cables inside ducts.

.3 Install multiple cables in duct simultaneously.

.4 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.

.5 To facilitate matching of colour coded multi-conductor control cables reel off in same direction during installation.

.6 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.

.7 After installation of cables, seal duct ends with duct sealing compound.

3.3 FIELD QUALITY CONTROL

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

.2 Perform tests using qualified personnel.

.3 Include necessary instruments and equipment.

.4 Check phase rotation and identify each phase conductor of each feeder.

.5 Check each feeder for continuity, short circuits and grounds.

.6 Ensure resistance to ground of circuits is not less than 50 megaohms.

.7 Acceptance Tests shall be in accordance with Section 26 08 05 – Acceptance Testing.

.8 Provide the consultant with list of test results showing location at which each test was made, circuit tested and result of each test.

.9 Remove and replace entire length of cable if cable fails to meet any of test criteria.

3.4 CLEANING

.1 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.5 PROTECTION

.1 Repair damage to adjacent materials caused by cable installation.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)

.1 ANSI/IEEE 837-2014, Qualifying Permanent Connections Used in Substation Grounding.

.2 Canadian Standards Association, (CSA International)

Part 2 Products

2.1 EQUIPMENT

.1 Ground bus:

.1 Material: Tin plated copper

.2 Size: As per drawings.

.2 Grounding conductors: bare stranded copper, soft annealed, size as indicated.

.3 Insulated grounding conductors: green, type RW90.

.4 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:

.1 Grounding and bonding bushings.

.2 Protective type clamps.

.3 Bolted type conductor connectors.

.4 Thermit welded type conductor connectors.

.5 Bonding jumpers, straps.

.6 Pressure wire connectors.

Part 3 Execution

3.1 INSTALLATION GENERAL

.1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.

.2 Install connectors in accordance with manufacturer's instructions.

.3 Protect exposed grounding conductors from mechanical injury.

.4 Use mechanical connectors for grounding connections to equipment provided with lugs.

.5 Soldered joints not permitted.

3.2 SYSTEM AND CIRCUIT GROUNDING

.1 Install system and circuit grounding connections to neutral of primary 600 V system and secondary 120 V system.

3.3 EQUIPMENT GROUNDING

.1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting.

3.4 GROUNDING BUS

.1 Install copper grounding bus mounted on insulated supports on wall of electrical room.

.2 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size 2/0 AWG.

3.5 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Contract Administrator and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

.4 Disconnect ground fault indicator during tests.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 01 – Common Works Results – For Electrical

Part 2 Products

2.1 FRAMING AND SUPPORT SYSTEM

.1 Materials:

.2 Conduit support structures shall employ an Fibre Glass strut framing system together with the manufacturer's connecting components and fasteners for a complete system.

.3 Finishes:

.1 Corrosive location: Fibre Glass

.2 Indoors, dry locations: Fibre Glass.

.3 All threaded rod, nuts, bolts, spacers: Fibre Glass.

.4 B-line Series Strut Systems or approved equal.

2.2 CONCRETE AND MASONRY ANCHORS

.1 Materials: hardened steel inserts, zinc plated for corrosion resistance.

.2 Components: non-drilling anchors for use in predrilled holes, sized to safely support the applied load with a minimum safety factor of four.

.3 Manufacturer: Hilti (Canada) Limited or approved equal in accordance with B6.

Part 3 Execution

3.1 INSTALLATION

.1 Secure equipment to solid masonry, tile and plaster surfaces with galvanized anchors.

.2 Secure equipment to poured concrete with expandable inserts.

.3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts, unless otherwise indicated.

.4 Do not drill through steel reinforcement encased in concrete.

.5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.6 Maximum spacing between conduit supports:

.1 As per 26 05 34.

.7 Fasten exposed conduit or cables to building construction or support system using clamps.

.1 fibre glass conduit clamps to secure surface conduits and cables 50 mm and smaller.

.8 Suspended support systems.

.1 Support individual cable or conduit runs with 6 mm dia threaded fibre glass rods and spring clips.

.2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded fibre glass rod hangers where direct fastening to building construction is impractical.

.9 For surface mounting of two or more conduits use channels, with maximum centre spacing as indicated above.

.10 Provide fibre glass brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.11 Ensure adequate support for raceways and cables dropped vertically where there is no wall support.

.12 Do not use wire lashing or perforated strap to support or secure cables.

.13 Do not 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.

.14 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 01 – Common Works Results – For Electrical

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Include detail construction, dimension, capacities, weights of equipment or material.

Part 2 Products

2.1 SPLITTERS

.1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

.2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.

.3 At least three spare terminals on each set of lugs in splitters less than 400 A.

.4 Non metallic splitter for installation in corrosive environment.

.5 Approved Manufacturer: Hoffman or approved equal.

2.2 JUNCTION AND PULL BOXES

.1 Welded steel construction with screw-on flat covers for surface mounting.

.2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.

.3 Non metallic junction box for installation in corrosive environment.

.4 Approved Manufacturer: Hoffman or approved equal.

2.3 CABINETS

.1 Type E: sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.

.2 Type T: sheet steel cabinet, with hinged door, latch, lock, 2 keys, containing sheet steel backboard for surface mounting.

.3 Non metallic cabinets for installation in corrosive environment.

.4 Approved Manufacturer: Hoffman or approved equal.

Part 3 Execution

3.1 SPLITTER INSTALLATION

.1 Install splitters and mount plumb, true and square to the building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Mount cabinets with top not higher than 2 m above finished floor.

.3 Install terminal block as indicated in Type T cabinets.

.4 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

3.3 IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Install size 2 identification labels indicating system name, voltage and phase.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1, Canadian Electrical Code, Part 1, 20th Edition.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit product data in accordance with Section 01 00 00 – General Provisions of this Bid Opportunity.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

.1 Size boxes in accordance with CSA C22.1.

.2 102 mm square or larger outlet boxes as required.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 Combination boxes with barriers where outlets for more than one system are grouped.

.6 Material Requirements:

.1 Ferric Chloride Tank Area: PVC
.2 Sodium Hydrochloride Tank Area: PVC
.3 Railcar Shelter: PVC

.7 Where conduit serves an area where metal material is required, utilize metal conduit, boxes, and fittings for the entire conduit run.

2.2 SURFACE MOUNTED OUTLET BOXES FOR PVC CONDUIT

.1 General Requirements:

.1 To CSA C22.2 No. 18.
.2 Acceptable materials:
.1 PVC
.3 Grounding stud.
.4 Mounting lugs as required.
.5 NEMA 4X, unless otherwise indicated.

.2 Specific Requirements:

.1 Ceiling Outlets:
.1 IPEX OB series
.2 Device Boxes:
.1 IPEX FS/FD series

2.3 CONDUIT BOXES FOR PVC CONDUIT

.1 Non-metallic PVC boxes with mounting feet for surface wiring of devices.

.2 Acceptable products: Ipex

2.4 FITTINGS - GENERAL

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

Part 3 Execution

3.1 INSTALLATION

.1 Provide boxes sized as required by the Canadian Electrical Code.

.2 Support boxes independently of connecting conduits.

.3 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.

.4 Vacuum clean interior of outlet boxes before installation of wiring devices.

.5 Provide permanent identification label for all device boxes as per City of Winnipeg - Identification Standard – 510276-0000-40ER-0002.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 01 – Common Works Results – For Electrical

1.2 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CAN/CSA C22.2 No. 18.1-13 (R2018), Metallic outlet boxes (Tri-national standard, with UL 514A and ANCE NMX-J-023/1).

.2 CSA C22.2 No. 45-M1981(R2008), Rigid Metal Conduit.

.2 City of Winnipeg

.1 Identification Standard – 510276-0000-40ER-0002.

.2 Tag Naming Standard – 612620-0014-40ER-0001.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials.

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

.4 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling.

Part 2 Products

2.1 CONDUITS

.1 Rigid PVC conduit: to CSA C22.2 No. 211.2.

.2 PVC coated rigid steel conduits cUL listed, file number DYJC E226472

2.2 CONDUIT FASTENINGS

.1 Fibre glass conduit fastenings.

.2 fibre glass conduit clamp for surface conduits 21mm and larger.

.3 Fibre glass beam clamps to secure conduits to exposed steel work.

.4 Fibre glass channel type supports for two or more conduits at 1.5 m oc.

.5 Fibre glass Threaded rods, 6 mm dia., to support suspended channels.

2.3 CONDUIT FITTINGS

.1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.

.2 Factory "ells" where 90° bends are required for 25 mm and larger conduits.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

.1 PVC coated expansion fittings for rigid steel conduits.

.2 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.

.3 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.

.4 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 FISH CORD

.1 Polypropylene.

Part 3 Execution

3.1 INSTALLATION

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Conceal conduits in finished areas.

.3 Surface mount conduits except in mechanical and electrical service rooms and in unfinished areas.

.4 Use rigid aluminum conduit for exterior installation.

.5 Use rigid PVC in corrosive locations where aluminum is not suitable.

.6 Use rigid PVC of underground installations and in poured concrete walls and floors.

.7 Use PVC coated rigid steel conduit for fire alarm wiring.

.8 Minimum conduit size for lighting and power circuits: 21 mm.

.9 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.10 Mechanically bend steel conduit over 19 mm dia.

.11 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.12 Install fish cord in empty conduits.

.13 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.

.14 Dry conduits out before installing wire.

3.2 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on suspended or surface channels.

.5 Do not pass conduits through structural members except as indicated.

.6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

.7 Provide stand-of conduit clamp / clip.

3.3 CONCEALED CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Do not install horizontal runs in masonry walls.

.3 Do not install conduits in terrazzo or concrete toppings.

3.4 CONDUITS IN CAST-IN-PLACE CONCRETE

.1 Locate to suit reinforcing steel. Install in centre one third of slab.

.2 Protect conduits from damage where they stub out of concrete.

.3 Install sleeves where conduits pass through slab or wall.

.4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.

.5 Do not place conduits is slabs in which slab thickness is less than 4 times conduit diameter.

.6 Encase conduits completely in concrete with minimum 25 mm concrete cover.

.7 Organize conduits in slab to minimize cross-overs.

3.5 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

.1 Run conduits 25 mm and larger below slab and encased in 75 mm concrete envelope. Provide 50 mm of sand over concrete envelope below floor slab.

3.6 CONDUITS UNDERGROUND

.1 Slope conduits to provide drainage.

.2 Waterproof joints (pvc excepted) with heavy coat of bituminous paint.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA C22.1 No.126.1-17, Metal Cable Tray Systems.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data: submit manufacturer's product data sheets for cable tray indicating dimensions, materials, and finishes, including classifications and certifications.

.3 Shop Drawings: submit shop drawings showing materials, finish, dimensions, accessories, layout, and installation details.

.4 Identify types of cabletroughs used.

.5 Show actual cabletrough installation details and suspension system.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials.

.2 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling.

Part 2 Products

2.1 CABLETROUGH

.1 Cabletroughs and fittings: to CAN/CSA C22.1 No.126.1.

.2 Ladder type, Class E to CAN/CSA C22.2 No. 126.1.

.3 Trays: Fibreglass, width as indicated on drawings.

.4 Fibreglass fittings: horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints and reducers where required, manufactured accessories for cabletrough supplied.

.1 Radii on fittings: 600mm minimum.

.5 Fibreglass solid covers for complete cabletrough system including fittings.

.6 Fibreglass barriers where different voltage systems are in same cabletrough.

.7 Ground cable trays with #2 AWG bare copper conductor attached to each tray section in accordance with CEC requirements.

.8 Provide fire stop material at firewall penetrations.

.9 Approved manufacturer: B-Line Series Cable Tray System

2.2 SUPPORTS

.1 Provide splices, supports for a continuously grounded system as required.

.2 Use fibreglass support system, bolting and fixing hardware.

Part 3 Execution

3.1 INSTALLATION

.1 Install complete cabletrough system.

.2 Support cabletrough on both sides.

.3 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.

3.2 CABLES IN CABLETROUGH

.1 Install cables individually.

.2 Lay cables into cabletrough. Use rollers when necessary to pull cables.

.3 Secure cables in cabletrough at 2m centres, with nylon ties.

.4 Identify cables every 8m with size 2 nameplates.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 CSA International

.1 CAN/CSA-C22.2 No.47-13 (R2018), Air-Cooled Transformers (Dry Type).

.2 CSA C9-17, Dry-Type Transformers.

.3 CAN/CSA-C802.2-18, Minimum Efficiency Values for Dry Type Transformers.

.2 National Electrical Manufacturers Association (NEMA)

.3 Canada's Energy Efficiency Act and Energy Efficiency Regulations

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

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

1.3 CLOSEOUT SUBMITTALS

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

.2 Operation and Maintenance Data: submit operation and maintenance data for dry type transformers for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

.1 Store and protect dry type transformers from nicks, scratches, and blemishes.

.2 Replace defective or damaged materials with new.

Part 2 Products

2.1 DESIGN DESCRIPTION

.1 XFMR-F7000.

.1 Type: ANN.

.2 3 phase, 45kVA

.3 Voltage taps: Minimum two taps above and two taps below at 2.5% increments, full capacity.

.4 Insulation: 150°C Rise

.5 Basic Impulse Level (BIL): standard.

.6 Hipot: standard.

.7 Average sound level: standard.

.8 Impedance at 17 degrees C: standard.

.9 Enclosure: NEMA 3R.

.10 Mounting: Wall

.11 Finish: in accordance with Section 26 05 00- Common Work Results for Electrical.

.12 Copper windings.

.13 Lifting hooks for lifting complete transformer assembly.

.2 XFMR-W7100.

.1 Type: ANN.

.2 3 phase, 30kVA

.3 Voltage taps: Minimum two taps above and two taps below at 2.5% increments, full capacity.

.4 Insulation: 150°C Rise

.5 Basic Impulse Level (BIL): standard.

.6 Hipot: standard.

.7 Average sound level: standard.

.8 Impedance at 17 degrees C: standard.

.9 Enclosure: NEMA 3R.

.10 Mounting: Wall

.11 Finish: in accordance with Section 26 05 00- Common Work Results for Electrical.

.12 Copper windings.

.13 Lifting hooks for lifting complete transformer assembly.

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00- Common Work Results for Electrical.

.2 Label size: 7.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for transformers 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 Mount dry type transformers up to 75 kVA as indicated on drawings.

.2 Mount dry type transformers above 75 kVA on floor.

.3 Ensure adequate clearance around transformer for ventilation.

.4 Install transformers in level upright position.

.5 Remove shipping supports only after transformer is installed and just before putting into service.

.6 Loosen isolation pad bolts until no compression is visible.

.7 Make primary and secondary connections in accordance with wiring diagram.

.8 Energize transformers after installation is complete.

.9 Make conduit entry into bottom 1/3 of transformer enclosure.

3.3 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by dry type transformers installation.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for standard and custom breaker type panelboards.

1.2 RELATED SECTIONS

.1 Section 26 05 01 - Common Work Results - Electrical.

.2 Section 26 28 21 - Moulded Case Circuit Breakers.

.3 Section 01 00 00 – General Provisions.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.29-M1989 (R2000), Panelboards and Enclosed Panelboards.

.2 City of Winnipeg

.1 Identification Standard – 510276-0000-40ER-0002.

.2 Tag Naming Standard – 612620-0014-40ER-0001.

1.4 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 00 00 – General Provisions of this Bid Opportunity.

.2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

Part 2 - Products

2.1 PANELBOARDS

.1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.

.1 Install circuit breakers in panelboards before shipment.

.2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

.2 250 V panelboards: Bus and breakers rated as indicated on drawings. 10 kA (symmetrical) interrupting capacity minimum.

.3 600 V panelboards: Bus and breakers rated as indicated on drawings. 22 kA (symmetrical) interrupting capacity minimum.

.4 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.

.5 Panelboards: tin plated copper mains, number of circuits, and number and size of branch circuit breakers as indicated.

.6 Enclosure type: as indicated on drawings.

.7 Two keys for each panelboard and key panelboards alike.

.8 Tin plated copper bus with neutral of same ampere rating as mains.

.9 Mains: suitable for bolt-on breakers.

.10 Trim with concealed front bolts and hinges.

.11 Trim and door finish: baked grey enamel.

2.2 BREAKERS

.1 Breakers: to Section 26 28 21 - Moulded Case Circuit Breakers.

.2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

.3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

.4 Lock-on devices for 10% of 15 to 30 A breakers installed as indicated. Turn over unused lock-on devices to City of Winnipeg.

2.3 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Nameplate for each panelboard Size 4 engraved as indicated.

.3 Nameplate for each circuit in distribution panelboards Size 2 engraved as indicated.

.4 Complete circuit directory with typewritten legend showing location and load of each circuit.

Part 3 - Execution

3.1 INSTALLATION

.1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

.2 Install surface mounted panelboards on plywood backboards. Where practical, group panelboards on common backboard.

.3 Mount panelboards to height specified in Section 26 05 01 - Common Work Results - Electrical or as indicated.

.4 Connect loads to circuits.

.5 Connect neutral conductors to common neutral bus with respective neutral identified.

.6 Provide lesser of 20% spare 15A breakers or 5 spare breakers.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 01 – Common Works Results – For Electrical

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Indicate detail construction, dimension, capacities, weights and electrical performance characteristics of equipment or material.

Part 2 Products

2.1 MATERIALS

.1 NEMA 4X rated enclosure for all locations except within electrical rooms and control rooms.

.2 NEMA 12 rated enclosures for devices within electrical rooms or control rooms unless otherwise specified.

.3 Door: minimum 1 m wide, hinged, minimum 3-point latching, with padlocking means.

.4 Door interlocks

Part 3 Execution

3.1 INSTALLATION

.1 Assemble enclosure in accordance with manufacturer's instructions and mount on concrete pad.

.2 Mount equipment in enclosure.

END OF SECTION

Part 1 General

1.1 Section Includes

.1 Switches, receptacles, wiring devices, cover plates and their installation.

1.2 Related Sections

.1 Section 26 05 01 - Common Work Results - Electrical.

.2 Section 01 00 00 – General Provisions of this Bid Opportunity.

1.3 References

.1 Canadian Standards Association (CSA International)

.1 CSA-C22.2 No.42-99 (R2002), General Use Receptacles, Attachment Plugs and Similar Devices.

.2 CSA-C22.2 No.42.1-00, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).

.3 CSA-C22.2 No.55-M1986 (July 2001), Special Use Switches.

.4 CSA-C22.2 No.111-00, General-Use Snap Switches (Bi-national standard, with UL 20, twelfth edition).

.2 City of Winnipeg

.1 Identification Standard – 510276-0000-40ER-0002.

.2 Tag Naming Standard – 612620-0014-40ER-0001.

1.4 Shop Drawings And Product Data

.1 Submit shop drawings and product data in accordance with Section 01 00 00 – General Provisions of this Bid Opportunity.

PART 2 - PRODUCTS

2.1 Switches

.1 15 A, 120 V, single pole, double pole, three-way, four-way industrial grade switches to: CSA-C22.2 No.55 and CSA-C22.2 No.111 as required.

.2 Manually-operated general purpose AC switches with following features:

.1 Terminal holes approved for No. 10 AWG wire.
.2 Silver cadmium oxide contacts.
.3 Fully enclosed with urea or melamine moulding for parts subject to carbon tracking.
.4 Suitable for back and side wiring.
.5 Brown toggle.

.3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.

.4 Switches of one manufacturer throughout project.

.5 Acceptable materials: Hubbell 1200 Series or equivalent.

2.2 Receptacles

.1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA-C22.2 No.42 with following features:

.1 Brown urea moulded housing.
.2 Suitable for No. 10 AWG for back and side wiring.
.3 Break-off links for use as split receptacles.
.4 Eight back wired entrances, four side wiring screws.
.5 Triple wipe contacts and riveted grounding contacts.

.2 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:

.1 Brown urea moulded housing.
.2 Suitable for No. 10 AWG for back and side wiring.
.3 Four back wired entrances, 2 side wiring screws.

.3 Other receptacles with ampacity and voltage as indicated.

.4 Receptacles of one manufacturer throughout project.

.5 Acceptable materials: Hubbell 5252 or equivalent.

2.3 WELDING RECEPTACLES

.1 60 A, 600 V, three phase welding receptacles with integral disconnect switch.

.2 Contractor to coordinate to ensure only a single receptacle type will provided in the facility.

.3 Corrosion and impact resistant.

.4 Non-fused type. NEMA 4 enclosure.

.5 Acceptable materials: Crouse-Hinds Arktite interlocked receptacles or equivalent.

2.4 Cover Plates

.1 PVC cover plates for wiring devices.

.2 Cover plates from one manufacturer throughout project.

.3 Stainless steel, vertically brushed, 1 mm thick cover plates for wiring devices mounted in flush-mounted outlet box.

.4 Weatherproof double lift spring-loaded PVC cover plates, complete with gaskets for duplex receptacles as indicated on the drawings.

.5 Weatherproof spring-loaded PVC cover plates complete with gaskets for single receptacles or switches as indicated on the drawings.

PART 3 - EXECUTION

3.1 Installation

.1 Switches:

.1 Install single throw switches with handle in "UP" position when switch closed.

.2 Install switches in gang type outlet box when more than one switch is required in one location.

.3 Mount toggle switches at height in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Receptacles:

.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.

.2 Mount receptacles at height in accordance with Section 26 05 01 - Common Work Results - Electrical.

.3 Where split receptacle has one portion switched, mount vertically and switch upper portion.

.4 Mount lighting fixture receptacles local to fixtures.

.3 Cover plates:

.1 Protect cover plate finish with paper or plastic film until painting and other work is finished.

.2 Install suitable common cover plates where wiring devices are grouped.

.3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

.4 Welding Receptacles.

.1 Mount welding receptacles at 1.2 m.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

.1 CSA International

.1 CSA C22.2 No. 5-16, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMX-J-266-ANCE-2016).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

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

.3 Include time-current characteristic curves for breakers with ampacity of 100 A and over.

.4 Certificates:

.1 Prior to installation of circuit breakers in either new or existing installation, Contractor must submit 2 copies of a production certificate of origin from the manufacturer. Production certificate of origin must be duly signed by factory and local manufacturer's representative certifying that circuit breakers come from this manufacturer and are new and meet standards and regulations.

.1 Production certificate of origin must be submitted to Departmental Representative for approval.

.2 Delay in submitting production of certificate of origin will not justify any extension of contract and additional compensation.

.3 Any work of manufacturing, assembly or installation to begin only after acceptance of production certificate of origin by Departmental Representative. Unless complying with this requirement, Departmental Representative reserves the right to mandate manufacturer listed on circuit breakers to authenticate new circuit breakers under the contract, and to Contractor's expense.

.4 Production certificate of origin must contain:

.1 Manufacturer's name and address and person responsible for authentication. Person responsible must sign and date certificate.

.2 Licensed dealer's name and address and person of distributor responsible for Contractor's account.

.3 Contractor's name and address and person responsible for project.

.4 Local manufacturer's representative name and address. Local manufacturer's representative must sign and date certificate.

.5 Name and address of building where circuit breakers will be installed.

1.3 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

.1 Store and protect circuit breakers from nicks, scratches, and blemishes.

.2 Replace defective or damaged materials with new.

Part 2 Products

2.1 BREAKERS GENERAL

.1 Ground-fault circuit-interrupters, Circuit breakers, and Moulded-case circuit breakers: to CSA C22.2 No. 5

.2 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation.

.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.

.5 Circuit breakers with interchangeable trips as indicated.

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.

Part 3 Execution

3.1 FACTORY TESTING

.1 Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of the CSA standard.

3.2 INSTALLATION

.1 Install circuit breakers as indicated on drawings per the manufacturer's recommendations.

3.3 FIELD SETTINGS

.1 The contractor shall perform field adjustments of the circuit breakers as required to place the equipment in final operating condition. The settings shall be in accordance with the drawings.

3.4 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for fused and non-fused disconnect switches.

1.2 RELATED SECTIONS

.1 Section 26 05 01 – Common Works Results – For Electrical

.2 Section 26 28 14 - Fuses - Low Voltage.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CAN/CSA C22.2 No.4-16, Enclosed and Dead-front Switches.

.2 CSA C22.2 No.39-13 (R2017), Fuseholder Assemblies.

1.4 SHOP DRAWINGS AND PRODUCT DATA

.1 Indicate:

.1 Mounting method and dimensions.

.2 Enclosure types.

Part 2 Products

2.1 DISCONNECT SWITCHES

.1 Fusible, non-fusible, horsepower rated disconnect switch in CSA Enclosure, to CAN/CSA C22.2 No.4 sized as per drawings.

.2 Provision for padlocking in off switch position by three locks.

.3 Mechanically interlocked door to prevent opening when handle in ON position.

.4 Fuses: size as indicated on drawings, in accordance with Section 26 28 14 - Fuses - Low Voltage.

.5 Fuseholders: to CSA C22.2 No.39 relocatable and suitable without adaptors, for type and size of fuse indicated.

.6 Quick-make, quick-break action.

.7 ON-OFF switch position indication on switch enclosure cover.

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Indicate name of load controlled on size 4 nameplate.

Part 3 Execution

3.1 INSTALLATION

.1 Install disconnect switches complete with fuses if applicable.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 This Section covers items common to Sections Division 26, Electrical.

1.2 REFERENCE STANDARDS

.1 CSA International

.1 CSA C22.2 No.14-18, Industrial Control Equipment.

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA ICS 2-2000 (R2005), Controllers, Contactors and Overload Relays Rated 600 V.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

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

1.4 CLOSEOUT SUBMITTALS

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

.2 Operation and Maintenance Data: submit operation and maintenance data for contactors for incorporation into manual.

.3 Include operating information required for start-up, synchronizing and shut-down of generating units.

1.5 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

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

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

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 CONTACTORS

.1 Contactors: to CSA C22.2 No.14.

.2 Electrically held and controlled by pilot devices as indicated and rated for type of load controlled. Half size contactors not accepted.

.3 Complete with 2 normally open and 2 normally closed auxiliary contacts unless indicated otherwise.

.4 Mount in NEMA 4X NON metallic Enclosure

.5 Include following options in cover:

.1 Red or Green indicating lamp, as indicated.

.2 Stop-Start pushbutton, as indicated.

.3 Hand-Off-Auto selector switch, as indicated.

.4 On-Off selector switch, as indicated.

.6 Control transformer: in accordance with Section 26 29 03- Control Devices, factory wired and installed in contactor enclosure.

2.2 EQUIPMENT IDENTIFICATION

.1 Identify equipment in accordance with Section 26 05 00- Common Work Results for Electrical.

.2 Size 4 nameplate as indicated.

Part 3 Execution

3.1 INSTALLATION

.1 Install contactors and connect power wires and auxiliary control devices.

.2 Identify contactors with nameplates or labels indicating panel and circuit number.

.3 Test contactors in accordance with 26 05 00- Common Work Results for Electrical.

3.2 CLEANING

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

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

3.3 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by contactor installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 This Section covers items common to Sections Division 26, Electrical.

1.2 REFERENCE STANDARDS

.1 CSA International

.1 CSA C22.2 No.14-18, Industrial Control Equipment.

.2 National Electrical Manufacturers Association (NEMA)

.1 NEMA ICS 1-2000(R2008), Industrial Control and Systems: General Requirements.

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 control devices and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.

.2 Include schematic, wiring, interconnection diagrams.

1.4 QUALITY ASSURANCE

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

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 control devices for incorporation into manual.

1.6 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

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

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

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 AC CONTROL RELAYS

.1 Control Relays: to NEMA ICS 1 CSA C22.2 No.14.

.2 Convertible contact type: contacts field convertible from NO to NC, permanent magnet latched electrically held, double-voltage type with sliding barrier to permit access to contacts only or coil only, with pneumatic, solid-state timer. Coil rating: overlap type.

2.2 RELAY ACCESSORIES

.1 Standard contact cartridges: normally-open - convertible to normally-closed in field.

2.3 PUSHBUTTONS

.1 Operator mushroom type. Black, with 1-NO and 1-NC, labels as indicated. Stop pushbuttons coloured red, labelled "Stop".

2.4 SELECTOR SWITCHES

.1 Standard 2 position labelled as indicated.

2.5 INDICATING LIGHTS

.1 Standard, full voltage, type, lens colour: as indicated, supply voltage: as indicated, lamp voltage: labels as indicated.

2.6 CONTROL AND RELAY PANELS

.1 CSA Type 4 sheet steel enclosure with hinged padlockable access door, accommodating relays timers, labels, as indicated, factory installed and wired to identified terminals.

2.7 CONTROL CIRCUIT TRANSFORMERS

.1 Single phase, dry type.

.2 Primary: 600V, 60 Hz ac.

.3 Secondary: 120 V, AC.

.4 Rating: 50VA.

.5 Secondary fuse: 3A.

.6 Close voltage regulation as required by magnet coils and solenoid valves.

2.8 THERMOSTAT (LINE VOLTAGE)

.1 Wall mounted, for exhaust fan and unit heater control.

.2 Full load rating: 8A at 120V AC.

.3 Temperature setting range: 5 degrees Celsius – 25 degrees Celsius.

.4 Thermometer Range: 0-30 degrees Celsius.

.5 Markings in 5 degrees increments.

Part 3 Execution

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for control devices 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 Install pushbutton stations, control and relay panels, and control devices.

3.3 FIELD QUALITY CONTROL

.1 Perform tests 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 time and check out operation of section.

.3 Upon completion of sectional test, undertake group testing.

.4 Check out complete system for operational sequencing.

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

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 01 – Common Works Results – For Electrical

1.2 REFERENCES

.1 National Electrical Manufacturer's Association (NEMA)

.1 NEMA Standards Publication ICS 2-2000: Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts.

1.3 SUBMITTALS

.1 Provide submittals in accordance with Section 01 00 00 – General Provisions of this Bid Opportunity.

.2 Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Provide shop drawings: in accordance with Section 01 00 00 – General Provisions.

.1 Provide shop drawings for each type of starter to indicate:

.1 Mounting method and dimensions.

.2 Starter size and type.

.3 Layout and components.

.4 Enclosure type.

1.4 CLOSEOUT SUBMITTALS

.1 Provide maintenance materials in accordance with Section 01 00 00 – General Provisions.

.2 Submit operation and maintenance data for each type and style of motor starter for incorporation into maintenance manual.

.3 Extra Materials:

.1 Provide listed spare parts for each different size and type of starter.

.1 All control fuses.

.2 1 indicating lamp bulb.

Part 2 Products

2.1 MATERIALS

.1 Starters: to NEMA ICS 2-2000

2.2 FULL VOLTAGE REVERSING STARTERS

.1 Magnetic and combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:

.1 Contactor solenoid operated, rapid action type.

.2 Intelligent electronic motor overload protective relay completes with a Modbus/TCP communication interface to connect to the control system PLC.

.1 Acceptable Product: Schneider Electric Tesys T

.3 Wiring and schematic diagram inside starter enclosure in visible location.

.4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.

.2 Combination type starters to include motor circuit interrupter.

.3 Accessories:

.1 Pushbuttons and selector switches: heavy duty oil tight labelled as indicated.

.2 Indicating lights: heavy duty oil tight type and color as indicated.

.3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

2.3 CONTROL TRANSFORMER

.1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V secondary, complete with secondary fuse, installed in with starter as indicated.

.2 Size control transformer for control circuit load plus 20% spare capacity.

2.4 FINISHES

.1 Apply finishes to enclosure in accordance with Section 26 05 01 - Common Work Results - Electrical.

2.5 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Magnetic starter designation label, white plate, black letters, size 4 engraved as indicated.

Part 3 Execution

3.1 INSTALLATION

.1 Install starters, connect power and control as indicated.

.2 Ensure correct fuses and overload devices elements installed.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical and manufacturer's instructions.

.2 Operate switches, contactors to verify correct functioning.

.3 Perform starting and stopping sequences of contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Technical requirements related to the design and supply of Variable Frequency Drives (VFD), including all equipment, manufacture, assembly, factor, wiring, inspection, testing and delivery.

1.2 REFERENCE STANDARDS

.1 CSA, Canadian Standards Association

.2 NEMA, National Electrical Manufacturer Association

.3 IEEE, The Institute of Electrical and Electronics Engineers

.4 Other, Local Power Utility and Telephone Utility Guidelines for Harmonic Distortion.

1.3 DESIGN REQUIREMENTS

.1 Provide equipment layout drawing detailing

.1 The dimensions, physical arrangement of major components, and the degree of compartmentalization and physical segregation provided between components

.2 Front layout of the panel

.3 When air-cooled systems are provided, the following shall also be shown:

.1 air inlet and outlet passages

.2 cooling fans

.3 filters.

1.4 SUBMITTALS

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

.2 Submit shop drawings including:

.1 Panel layout.

.2 Wiring diagrams:

.1 AutoCAD versions of the VFD schematic drawings will be provided upon request.

1.5 PARTS AVAILABILITY

.1 Guarantee that parts for the drive units be available for a minimum of ten years from time of delivery.

1.6 DESIGN REQUIREMENTS

.1 Ventilation system designed for ambient temperature range of 10°C to 35°C. temperature not to exceed 45°C.

Part 2 Products

2.1 VARIABLE FREQUENCY DRIVES

.1 Variable speed controller shall be electronic adjustable frequency and voltage output unit.

.2 Designed to operate standard squirrel cage induction motor with a 1.15 S.F. or definite purpose motors meeting NEMA MG1 Part 31.

.3 Harmonic loading will not exceed a motor service factor of 1.0.

.4 Products shall comply with IEEE standard 519.

.5 CSA certified.

.6 The VFD shall employ a minimum of 6-pulse pulse width modulated (PWM) system utilizing insulated Gate Bipolar Transistors (IGBT) power switching device and come complete with line reactors.

.7 Be capable of re-accelerating the driven equipment, following voltage dips greater than 20% of the rated input power supply, of up to 5 seconds duration, without the need to come to a complete stop. Vendor shall indicate the maximum time delay before re- acceleration begins following restoration of the supply voltage.

.8 Be capable to continue operation without coming to a standstill or resulting in 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.

.9 Designed to provide output requirements dictated by the speed/torque characteristics of motor and driven equipment over the entire speed range. The motors may be supplied by others.

.10 VFD shall convert the line input power to adjustable AC voltage and frequency output power. 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 ±10% and frequency variation of ± 5%.

.11 The VFD output frequency shall not deviate more than ± 1% of any given set point within the operating frequency range.

.12 The VFD shall be provided with radio interference suppression and limit radio interference values to within the limits of local code requirements.

.13 Input Run Command signal will be a 24Vdc discrete signal. Provide a 24Vdc relay in the VFD control compartment.

.14 Input frequency setting signal will be 0-10 VDC and 4-20 mA. Output speed and current monitoring signals will be 4-20 mA.

.15 Enclosure

.1 VFD shall be installed in Type 12 wall mounted enclosure within the electrical room.

.2 VFD shall be installed Type 4X non-metallic wall mounted enclosure in Ferric Chloride building.

.3 VFD shall be installed Type 4X stainless steel wall mounted enclosure in Sodium Chloride building.

.4 Filters to be provided for any forced air-cooled enclosures as required by the supplier. VFD(s) shall be suitable for the location installed and shall be able to operate under these conditions with no special cleaning requirements

.16 Operational features

.1 Integral flush mounted keypad on enclosure door for programming, monitoring, and operating the drive, accessible through password or other acceptable security measure only.

.2 Integral selector switches and pushbuttons, where shown on the drawings: heavy duty, oil-tight, 30mm.

.17 Diagnostic features

.1 Integral long life LED indicating lights on enclosure door.

.2 Indicating lights as follows:

.1 Running (Red)

.2 VFD Fault (Orange)

.18 As supplied by one of the following acceptable manufacturers:

.1 Schneider Electric

.1 This manufacturer was standardized by the City via RFP 756-2013. No alternates or substitutes will be accepted

2.2 TERMINALS

.1 Terminals as follows:

.1 Feed-through: Phoenix Contact 3046184 or approved equal in accordance with B7,

.2 Potential earth: Phoenix Contact 3046207 or approved equal in accordance with B7,

.3 Fused: Phoenix Contact 3046142 with 3036806 or approved equal in accordance with B7,

.4 End plate: Phoenix Contact 3047141 or approved equal in accordance with B7.

2.3 COOLING SYSTEM

.1 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 pump is started from VFD or bypass system or when enclosure reaches hi temperature.

.3 Provide adjustable hi temperature switch, with minimum range 10°C to 30°C.

2.4 WIRING

.1 Utilize the following wire colours for the types of voltage/signals indicated:

.1 120VAC Line: Black

.2 120VAC Control: Red

.3 120VAC Neutral: White

.4 24VDC Supply: Blue

.5	24VDC Control:	Blue
.6	24VDC Common:	Brown
.7	24VAC Supply:	Black
.8	24VAC Control:	Red
.9	24VAC Neutral:	White
.10	10VDC Supply:	Blue
.11	0-10VDC Signal:	Blue
.12	10VDC Common:	Brown
.13	Intrinsically Safe:	Light Blue
.14	4-20mA Signal:	White (+), Black (-)

.2 All conductors shall be securely fastened to terminals at both ends; no splices are allowed inside the panel.

.3 No more than two (2) conductors may be terminated under each terminal screw. All internal panel conductors shall be connected to the same side of a terminal block, and external conductors to the other side. The only exception is for fused terminals which require connection to the field side for internal wiring.

.4 All wires and cables inside the VFD panels shall be identified on both ends with non-

.5 erasable markers from.

.6 Identification shall follow the supplied documents, such as wiring diagrams.

.1 Label both ends of each wire.

.2 Utilize machine printed non-slip labels.

.3 Wherever possible wire labels shall be positioned to be read from the panel opening without removal of wire duct covers or other wiring.

.7 Individual conductors or wires exiting a cable shall be identified using non-erasable markers.

.8 The routing of all analog, digital, and power cable wiring inside VFD panels shall be segregated as much as possible, in distinct wiring ducts, by the type of signal they are carrying. All wires shall be physically protected by wiring ducts with covers. The wiring ducts shall be of sufficient size to be filled to a maximum of 50% when all wires are inside.

.9 All analog signal wiring shall be 18 AWG shielded twisted pairs such as Belden No. 8760, or an approved equivalent in accordance with B7. Shield wires exiting the jacket must be covered with a black heat shrink, and the overall cable at the jacket end must also be covered with a heat shrink.

.10 All 24 VDC or 120 VAC discrete signal panel wiring shall be 16 AWG TEW stranded conductor.

.1 Increase the size of power wiring, 12 AWG minimum.

.11 The sizes and colours of wires shall be in accordance with the CSA and the Canadian Electrical Code.

.12 The panel builder shall group and form wiring into a loop when going from a fixed part of the panel to a door. Each end of the loop shall be properly supported.

.13 Ethernet Patch Cords

.1 Requirements:

.1 CAT-6.

.2 Jacket colour: Blue.

.14 Wiring Duct

.1 All wires shall be run in narrow slot wiring duct such as such as Panduit or an approved equivalent in accordance with B7

.2 Wiring Duct shall be installed on both sides of the panel and between the DIN rails.

.3 Wire or cable, connected to internal device or arriving from external device, shall be uncovered by Wiring Duct for a maximum of 10 cm.

.4 120 VAC wires cannot share wiring duct with 10 VDC, 24 VDC or 4-20 mA wires, but can cross their path.

2.5 SPARE PARTS

.1 Provide, at minimum, the following spare parts:

.1 One cooling fan

.2 All control fuses

.3 One N.O. and N.C. contact block for control switches

.4 One form “C” relay

.2 Spare parts to be provided in a sealed plastic bag taped to side of enclosure interior

Part 3 Execution

3.1 INSTALLATION

.1 VFD cabinets shall be mounted in such a way that there is adequate room for ventilation and no build up of heat. The minimum clearance in front of VFDs is 1 m.

3.2 CONFIGURATION

.1 Submit settings sheet for review.

.2 Configure VFD parameters as specified on settings sheet.

.3 Include settings sheets in the O&M manuals

3.3 TESTS

.1 VFD units are to be factory tested prior to shipment. Provide confirmation from factory of actual tests completed and results.

.2 Confirm VFD capability to continue operation without coming to a standstill, 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 seconds.

.3 Confirm VFD capability to automatically re-accelerate following loss of voltage for up to five seconds.

.4 Field testing

.1 Provide on-site start-up, fine-tuning, commissioning, operator training, and instruction.

.2 Full-load functional test of the VFD shall be performed. The test shall prove the correct operation of all control functions, auxiliaries, protective systems, alarms and metering.

.3 Ensure shaft to ground voltages do not exceed 1.5 V at any speed or load requirement.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American National Standards Institute (ANSI)

.1 ANSI C82.1-97, Electric Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.
.2 ANSI C82.4-92, Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps.

.2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)

.1 ANSI/IEEE C62.41-1991, Surge Voltages in Low-Voltage AC Power Circuits.

.3 American Society for Testing and Materials (ASTM)

.1 ASTM F1137-88(1993), Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.

.4 United States of America, Federal Communications Commission (FCC)

.1 FCC (CFR47) EM and RF Interference Suppression.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 45 00 - Quality Control.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Engineer.

.3 Photometric data to include: VCP Table and spacing criterion.

Part 2 Products

2.1 LAMPS

.1 Lamps shall be as indicated on luminaire schedule on drawings.

.2 LED lamps shall have a minimum estimated lifespan of 50,000 hours, with colour temperature as indicated on luminaire schedule.

.1 copy of shipping transmittal submitted to Mile Rendulic at Building department.

2.2 LED DRIVER

.1 LED Driver: CSA certified, energy efficient type, IC electronic.

.1 Rating: 120 V, 60 Hz.
.2 Totally encased and designed for 40 degrees Celsius ambient temperature.
.3 Start-up ambient temperature of -20°C for indoor luminaires, and -40°C for outdoor luminaires.

.4 Power factor: minimum 95% with 95% of rated lamp lumens.
.5 Harmonics: 10 % maximum THD.
.6 Estimated lifespan equal or greater than LED lamps of respective luminaire.
.7 Sound rated: Class A.
.8 Mounting: integral with luminaire.

2.3 FINISHES

.1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

2.4 LUMINAIRES

.1 As indicated in luminaire schedule.

Part 3 Execution

3.1 INSTALLATION

.1 Locate and install luminaires as indicated.

.2 Provide adequate support to suit ceiling system.

3.2 WIRING

.1 Connect luminaires to lighting circuits:

.2 Install rigid PVC conduit or Teck 90 cable for luminaires.

3.3 LUMINAIRE SUPPORTS

.1 For suspended ceiling installations support luminaires independently of ceiling.

.2 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors (Nylon shields not acceptable) or as recommended by Anchor Construction Industrial Building Products Ltd for the specific surface & equipment being installed.

.3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.4 If there is potential of Asbestos Electrical Contractor must use a proper collection boot and HEPA vacuum whenever drilling of holes in facility.

.5 All steel channel support for wall and surface mounted luminaires to be PVC coated strut.

.6 All RGS conduit stem threaded on both sides shall be PVC coated. All hardware shall be rated for the application environment.

3.4 LUMINAIRE ALIGNMENT

.1 Align luminaires mounted in continuous rows to form straight uninterrupted line.

.2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for emergency lighting systems.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 26 05 21 - Wires and Cables (0-1000 V).

.3 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.2 No.141-M1985(R1999), Unit Equipment for Emergency Lighting.

1.4 SUBMITTALS

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

.2 Data to indicate system components, mounting method, source of power and special attachments.

1.5 WARRANTY

.1 For batteries, the 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 5 years and pro-rate charge on the second 5 years.

Part 2 Products

2.1 EQUIPMENT

.1 Battery Unit

.1 Emergency lighting equipment: to CSA C22.2 No.141.
.2 Supply voltage: 120 V, ac.
.3 Output voltage: 24 V dc.
.4 Operating time: 30 min.
.5 Battery: sealed, maintenance free.
.6 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01V for plus or minus 10% input variations, reverse polarity protected, modular construction.
.7 Solid state transfer circuit.
.8 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.

.9 Signal lights: solid state, for 'AC Power ON' and 'High Charge'.

.10 Automatic Self Testing Feature that test once a month, every 6 months and 12 months c/w visual and audible alarm and should indicate the following at a minimum:

.1 Battery Failure

.2 Battery Disconnect

.3 Charger Failure

.4 Lamp Failure

.5 Service Alarm

.6 AC on

.7 Charger on

.11 Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.

.12 Finish: White.

.13 Options required:

.1 Shelf

.2 Ammeter and Voltmeter

.3 Line cord & plug

.4 A.C./D.C. Terminal block capable of accepting #10 AWG Cu. Wire

.5 Six (6) AC circuit voltage sensing relays internal to battery

.6 Six (6) circuit DC fused panel Electronic lockout & brownout circuits

.7 Sealed dust-proof transfer relay, test switch and LED indicators

.8 RFI suppressors.

.9 Zone Sensing Control Panel

.2 Remote Lamp Heads

.1 Impact Resistant

.2 Flame retardant

.3 Injection molded thermoplastic

.4 Adjustable mounting

.5 345 degrees horizontal and 180 degrees vertical adjustment

.6 double heads

.7 Canopy shall be provided to fit a 4” octagon box

.8 White color

.9 Provide wire guards in Multipurpose Room

.10 Polycarbonate lens and tamperproof screws for washrooms

2.2 WIRING OF REMOTE HEADS

.1 Conduit: in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

.2 Conductors: in accordance with Section 26 05 21 - Wires and Cables 0-1000 V, sized in accordance with manufacturer's recommendations to minimize voltage drop.

Part 3 Execution

3.1 INSTALLATION

.1 Install unit equipment and remote mounted fixtures.

.2 Direct heads.

.3 Connect exit lights to unit equipment.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Atomic Energy Control Board Regulations

.2 Canadian Code for Preferred Packaging

.3 Canadian Standards Association (CSA)

.1 CSA C22.2 No.141- M1985(R1992), Unit Equipment for Emergency Lighting.

.2 CSA C860- 96, Performance of Internally-Lighted Exit Signs.

.4 National Fire Protection Association (NFPA) requirements

Part 2 Products

2.1 STANDARD UNITS

.1 Exit lights: to CSA C22.2 No.141 and CSA C860, packaged in accordance with the Canadian Code for Preferred Packaging guidelines.

.2 Housing: Industrial grade polyvinyl chloride with gasket around lenses and canopy.

.3 Face and back plates: Heavy-duty vandal resistant polycarbonate.

.4 Lamps: two - LED- over 500,000 hours.

.5 Operation: designed for over 100,000 hours of continuous operation without relamping.

.6 Face plate to remain captive for relamping.

.7 Exit signs to be green running man.

.8 Colour: White

.9 Self-powered with nickel-cadmium battery.

.10 Universal Mount.

Part 3 Execution

3.1 INSTALLATION

.1 Install exit lights.

.2 Connect fixtures to exit light circuits.

.3 Connect emergency lamp sockets to emergency circuits.

.4 Ensure that exit light circuit breaker is locked in on position.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Not Used.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA-C22.2 No. 214-02, Communications Cables (Bi-National standard with UL 444).

.2 Telecommunications Industry Association (TIA)/Electronic Industries Alliance (EIA)

.1 TIA/EIA-568-B.1-(2001), Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements.

.2 TIA/EIA-568-B.2-(2001), Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components.

.3 TIA/EIA-606-A-(2002), Administration Standard for the Commercial Telecommunications Infrastructure.

1.3 SYSTEM DESCRIPTION

.1 Structured telecommunications wiring system consist of unshielded-twisted-pair and optical fiber cables, terminations, connectors, cross-connection hardware and related equipment installed inside building for occupant's telecommunications systems, including voice (telephone), data, and image.

.2 Installed in physical star configuration with separate horizontal and backbone sub-systems.

.1 Horizontal cables link work areas to telecommunications rooms located on same floor.

.2 Telecommunications rooms linked to main terminal/equipment room (MT/ER) by backbone cables.

.3 MT/ER also linked to Entrance Room by backbone cables.

1.4 SUBMITTALS

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

.2 As-built Records and Drawings:

.1 Provide database reflecting cable installation and cross-connections.

.2 Provide electronic drawings in AutoCAD 2000 format depicting all construction.

.3 Provide two (2) bound complete hard-copy sets of as-built records to the Engineer.

.1 Provide and place one hard copy of as-built records for each telecommunications room in plan holder in each telecommunications room.

Part 2 Products

2.1 FOUR-PAIR 100 O BALANCED TWISTED PAIR CABLE

.1 Four-pair, 100 ohm balanced unshielded-twisted-pair (UTP) cable, flame test classification FT4 to: CSA-C22.2 No. 214, Category 5E to: TIA/EIA-568-B.2.

2.2 MULTI-PAIR 100 O BALANCED TWISTED PAIR CABLE

.1 100 ohm, 50 pairs, sheath consists of thermoplastic jacket without underlying metallic shield, Category 3 to: TIA/EIA-568-B.2, flame test classification FT4 to: CSA-C22.2 No. 214.

2.3 WORK AREA UTP 4-PAIR MODULAR JACK

.1 Eight-position modular jack ("RJ-45"), type Category 6 to: TIA/EIA-568-B.2:

.1 Mounted in compatible single gang faceplate, flush entry, four jack positions per faceplate. Each port equipped with field installed "RJ-45" jacks, type Category 6 to: TIA/EIA-568-B.2.

2.4 TERMINATION AND CROSS-CONNECTION HARDWARE FOR UTP

.1 IDC Terminal strips, 25 pair, for terminating multi pair

.4 Approvals: CSA FT-4-ST1

.5 Manufacturer and Model:

Corning 036EUL-T3601D2M or approved equal

.2 Multi-mode

.1 Fibre Category: OM3

.2 Maximum Attenuation:0.4 / 0.3 dB/

.3 Chemical Resistance: RoHS

.4 Approvals: CSA FT-4-ST1

.5 Manufacturer and Model:

Corning 036EUL-T3601D2M or approved equal

2.8 INDOOR FIBRE OPTIC CABLE

.1 In accordance with requirements of EIT/EIA 568, section 12.5

.2 Manufacturer:

Corning 040402R5Z200xxM (where xx is length in metres) or approved equal

Part 3 Execution

3.1 INSTALLATION OF TERMINATION AND CROSS-CONNECT HARDWARE

.1 Install termination and cross-connect hardware in rack as indicated and according to manufacturers' instructions. Identify and label as indicated to: TIA/EIA-606-A.

.2 Install consolidation points, as indicated according to manufacturer's instructions. Identify and label as indicated to: TIA/EIA-606-A.

3.2 INSTALLATION OF HORIZONTAL DISTRIBUTION CABLES

.1 Install horizontal cables as indicated in conduits and cable trays from telecommunication rooms to individual work-area jacks. Identify and label as indicated to: TIA/EIA-606-A.

.2 Support horizontal cables at intervals not exceeding 2 meters.

.3 Install horizontal cables from consolidation point to individual work-area jacks.

.1 Identify and label as indicated to: TIA/EIA-606-A.

.4 Coil spare cables and store in ceiling space in zone.

3.3 INSTALLATION OF BACKBONE CABLES

.1 Install backbone cables from each telecommunications room to main terminal/equipment room (MT/ER) as indicated and according to manufacturers' instructions.

.1 Identify and label as indicated to: TIA/EIA-606-A.

.2 Install backbone cables from MT/ER to carrier demarcation point in Entrance Room as indicated and according to manufacturer's instructions.

.1 Identify and label as indicated to: TIA/EIA-606-A.

3.4 INSTALLATION OF EQUIPMENT CABLES

.1 Install equipment cables from equipment patch panel as indicated.

.1 Identify and label as indicated to: TIA/EIA-606-A.

3.5 TELECOMMUNICATIONS BONDING

.1 To standards:

.1 ANSI J-STD-607-A-2002, Joint Standard - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.

.2 TIA/EIA-606-2002, Administration Standard for the Commercial Telecommunications Infrastructure.

3.6 FIELD QUALITY CONTROL

.1 Test horizontal UTP cables as specified below and correct deficiencies provide record of results as electronic record on CD.

.1 Perform tests for Permanent Link on installed cables, including spares:

Category 6 using certified level III tester to: TIA/EIA-568-B.2.

.2 Perform tests for Channel on 100% of cross-connected data horizontal cabling installed from each telecommunications room, including shortest and longest drops from each telecommunications room.

.2 Test backbone UTP cables as specified below and correct deficiencies: provide record of results as electronic record on CD.

.1 Perform tests for Permanent Link on 4-pair cables:

Category 6 using certified level III tester to: TIA/EIA-568-B.2.

.2 Perform Wire Map tests on multi-pair UTP cables to: TIA/EIA-568-B.1.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for fire alarm systems.
.2 Control panel to carry out fire alarm and protection functions including receiving alarm signals, initiating general alarm, supervising system continuously, actuating zone annunciators, and initiating trouble signals.
.3 Trouble signal devices.
.4 Power supply facilities.
.5 Manual alarm stations.
.6 Automatic alarm initiating devices.
.7 Audible signal devices.
.8 End-of-line devices.
.9 Visual alarm signal devices.
.10 Ancillary devices.
.11 Sustainable requirements for construction and verification.

1.2 REFERENCES

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.2 Building and Fire Codes (Latest Issue)

.1 National Building Code
.2 National Fire Code
.3 Manitoba Building Code
.4 Manitoba Fire Code
.5 Canadian Electrical Code
.6 City of Winnipeg By-Laws (updated)
.7 Canadian Standards Association

.3 Underwriter's Laboratories of Canada (ULC)

.1 CAN/ULC-S524-2006, Standard for the Installation of Fire Alarm Systems.
.2 CAN/ULC-S525-1999, Audible Signal Device for Fire Alarm Systems.
.3 CAN/ULC-S526-2002, Visual Signal Devices for Fire Alarm Systems.
.4 CAN/ULC-S527-1999, Control Units.
.5 CAN/ULC-S528-1991, Manual Pull Stations for Fire Alarm Systems.
CAN/ULC-S529-2002, Smoke Detectors for Fire Alarm Systems.
.6 CAN/ULC-S530-M1991, Heat Actuated Fire Detectors for Fire Alarm Systems.
.7 CAN/ULC-S531-2002, Standard for Smoke Alarms.
.8 CAN/ULC-S536-S537-2004, Burglar and Fire Alarm Systems and Components.

.4 National Fire Protection Agency

.1 NFPA 72-2002, National Fire Alarm Code.

.2 NFPA 90A-2002, Installation of Air Conditioning and Ventilating Systems.

1.3 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures.

.1 Submit Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.2 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Include:

.1 Layout of equipment.

.2 Zoning.

.3 Complete wiring diagram, including schematics of modules.

.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.

.2 Instructions: submit manufacturer's installation instructions.

.3 Manufacturer's Field Reports: manufacturer's field reports specified.

.4 Closeout Submittals:

.1 Submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals in accordance with ANSI/NFPA 20.

.2 Authority of Jurisdiction will delegate authority for review and approval of submittals required by this Section.

.3 Submit to Authority of Jurisdiction 2 sets of approved submittals and drawings immediately after approval but no later than 15 working days to prior to final inspection.

.4 Submit following:

.1 Manufacturer's Data for:

.1 Control panel and modules.
.2 Storage batteries.
.3 Battery charger.
.4 Manual pull stations.
.5 Heat detectors.
.6 Open-area smoke detectors.
.7 Duct smoke detectors.
.8 Alarm bells.
.9 Alarm horns.
.10 Visible appliances.
.11 Wiring.
.12 Ground rods.
.13 Conduit.
.14 Outlet boxes.
.15 Fittings for conduit and outlet boxes.

.16 Trouble buzzer.
.17 Surge suppression devices.
.18 Mark data which describe more than one type of item to indicate which type will be provided.
.19 Submit 1 original for each item and clear, legible, first-generation photocopies for remainder of specified copies.

.2 System wiring diagrams:
.1 Submit complete wiring diagrams of system showing points of connection and terminals used for electrical connections in the system.
.2 Show modules, relays, switches and lamps in control panel.

.3 Design data: Power Calculations:
.1 Submit design calculations new work specified to substantiate that battery capacity exceeds supervisory and alarm power requirements.
.2 Show comparison of detector power requirements per zone versus control panel smoke detector power output per zone in both standby and alarm modes.
.3 Show comparison of notification appliance circuit alarm power requirements with rated circuit power output.

.4 Schedules:
.1 Conductor wire marker schedule.

.5 Test Reports:
.1 Open-area 2-wire smoke detectors.
.2 Preliminary testing:
.1 Final acceptance testing.
.2 Submit for inspections and tests specified under Field Quality Control.

1.4 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: company or person specializing in fire alarm system installations with 10-years documented experience approved by manufacturer.

.2 Provide services of representative or technician from manufacturer of system, experienced in installation and operation of type of system being provided, to supervise installation, adjustment, preliminary testing, and final testing of system and to provide instruction to project personnel.

.3 Extra Materials:

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

.4 Maintenance Service:

.1 Provide one year's free maintenance with two inspections by manufacturer during warranty period. Inspection tests to conform to CAN/ULC-S536. Submit inspection report to Engineer.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

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

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

.2 Waste Management and Disposal:

.1 In accordance with Waste Management and Disposal Clauses from Section 26 05 01 – Common Work Results – For Electrical.

Part 2 Products

2.1 SUSTAINABLE REQUIREMENTS

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

2.2 MATERIALS

.1 Maintain warranty and listing of remaining devices.
.2 Equipment and devices: ULC listed and labelled and supplied by single manufacturer.
.3 Power supply: to CAN/ULC-S524.
.4 Audible signal devices: to CAN/ULC-S525.
.5 Visual signal devices: to CAN/ULC-S526.
.6 Control unit: to CAN/ULC-S527.
.7 Manual pull stations: to CAN/ULC-S528.
.8 Thermal detectors: to CAN/ULC-S530.
.9 Smoke detectors: to CAN/ULC-S529.
.10 Smoke alarms: to CAN/ULC-S531.
.11 Passive Graphic to WSD standards

2.3 SYSTEM OPERATION

.1 Provide complete, electrically supervised and automatic Fully Addressable, fire alarm system.

.2 Provide separate circuits from control panel to each zone of initiating devices. Transmission of signals from more than one zone over common circuit to control panel is prohibited.

.3 System shall be a Simplex 4007ES or compatible with the existing fire alarm panel in the Administration Building.

.4 Provide alarm relay card or module for remote monitoring of fire alarm panel alarm, trouble, and supervisory reporting status to City’s SCADA.

.5 Provide fibre-optic media and network interface card for connecting externally to other buildings.

.6 Single stage operation. Operation to actuation following:

.1 Manual station.
.2 Heat detector.

.3 Smoke detector.

.4 Automatic fire sprinkler system.

.5 Fire extinguishing system.

.7 Actuation of single operation device to initiate following:

.1 Building evacuation alarm devices to operate continuously.

.2 Transmit signal to fire department via monitoring station.

.3 Zone of alarm device to be indicated on control panel display.

.4 Operations to remain in alarm mode (except alarm notification appliances if manually silenced) until system is manually restored to normal.

.5 Shut down air handling units.

.8 Capability to program smoke detector status change confirmation on any or zones in accordance with CAN/ULC-S527, Appendix C.

2.4 POWER SUPPLY

.1 120 V, ac, 60 Hz input, 24 V dc output from rectifier to operate alarm and signal circuits, with standby power of gel cell batteries minimum expected life of 4 years, sized in accordance with NBC.

2.5 MANUAL ALARM STATIONS

.1 Provide conventional single action type with mechanical reset features.

.2 Stations: semi-flush mounted and type as indicated.

.1 For surface mounting provide station manufacturer's approved back box.

.2 Back box finish to match station finish.

.3 Equip each station with terminal strip with contacts of proper number and type to perform functions required.

.4 Station colour: red.-Fire,

.5 Provide station with visible indication of operation.

.6 Restoration to require use of key.

.1 Keys: identical throughout system for stations and control panel(s).

.7 Mount stations with operating lever not more than 1.2 m above finished floor.

2.6 AUTOMATIC ALARM INITIATING DEVICES

.1 Heat detectors: provide heat detectors designed for detection of fire by combination fixed temperature rate-of-rise principle.

.2 Combination Fixed Temperature Rate-Of-Rise Detectors (Spot Type): designed for semi-flush outlet box mounting and supported independently of conduit, tubing or wiring connections.

.1 Contacts: self-resetting after response to rate-of-rise actuation

.2 Operation under fixed temperature actuation to result in external indication.

.3 Detector units located in boiler rooms, showers, or other areas subject to abnormal temperature changes to operate on fixed temperature principle only.

.3 Rate Compensating Detector (Spot Type): designed for flush and surface outlet box mounting and supported independently of conduit, tubing or wiring connections.

.1 Detectors: hermetically sealed and automatically resetting type which will operate when ambient air temperature reaches detector setting regardless of rate of temperature rise.

.2 Detector operation: not be subject to thermal time lag.

.4 Open-Area Smoke Detectors: provide detectors designed for detection of abnormal smoke densities by photoelectric principle.

.1 Detectors: addressable type.

.2 Provide necessary control and power modules required for operation integral with control panel.

.3 Detectors and associated modules: compatible with control panel and suitable for use in supervised circuit.

.4 Malfunction of electrical circuits to detector or its control or power units to result in operation of system trouble signals.

.5 Equip each detector with visible indicator lamp that will flash when detector is in normal standby mode and glow continuously when detector is activated.

.6 Provide remote indicator lamps for each detector that is located beneath raised floors.

.7 Each detector: plug-in type with tab-lock or twist-lock, quick disconnect head and separate base in which detector base contains screw terminals for making wiring connections.

.8 Detector head: removable from its base without disconnecting wires. Removal of detector head from its base to cause activation of system trouble signals.

.9 Screen each detector to prevent entrance of insects into detection chamber(s).

.5 Photoelectric Detectors: operate on light scattering principle using LED light source.

.1 Detector: respond to both flaming and smouldering fires.

.6 Locate detectors in accordance with their listing by ULC and the requirements of NFPA 72 and CAN/ULC s524, except provide at least 2 detectors in rooms of 54 square meters or larger in area where detectors are required.

.7 Mount detectors at underside of ceiling or deck above unless otherwise indicated.

.1 For mounting heights greater than 3 m above floor level, reduce actual detector linear spacing from listed spacing as required by NFPA 72 and CAN/ULC s524.

.8 Temperature rating of detectors: in accordance with NFPA 72.

.9 Locate detectors minimum 300 mm to lighting fixtures and not closer than 600 mm to air supply or return diffuser.

.10 Ensure detectors, located in areas subject to moisture or exterior atmospheric conditions or hazardous locations as defined by NFPA 70, are approved for such locations.

.11 Provide detectors with terminal screw type connections.

.12 Removal of detector head from its base to cause activation of system trouble signals if detectors are provided with separable heads and bases.

2.7 AUDIBLE SIGNAL DEVICES

.1 Provide remote system trouble buzzer arranged to operate in conjunction with panel's integral trouble signal.

.2 Audible device(s):

.1 Bells: 95 db, semi-flush mounting, 24 V dc. Provide complete with strobes where indicated.

2.8 END-OF-LINE DEVICES

.1 End-of-line devices to control supervisory current in alarm circuits and signalling circuits, sized to ensure correct supervisory current for each circuit. Open, short or ground fault in any circuit will alter supervisory current in that circuit, producing audible and visible alarm at main control panel and remotely as indicated.

2.9 VISUAL ALARM SIGNAL DEVICES

.1 Flush-mounted assembly of stroboscopic type suitable for use in electrically supervised circuit and powered from notification appliance circuits.

.2 Appliances: minimum of 110 candela measured as approved by ULC.

.3 Protect lamps with thermoplastic lens and labelled "FIRE" in letters at least 12 mm high.

.4 Provide visible appliances within 300 mm of each audible appliance as indicated.

.5 Visible appliances may be part of audio-visual assembly, where more than two appliances are located in same room or corridor.

2.10 WIRING

.1 Wire for 120 V circuits: No. 12 AWG minimum solid copper conductor. Wire for low voltage DC circuits: No. 14 AWG minimum solid copper conductor

.2 All wiring for fire alarm system shall be run in a separate and independent pvc coated RGS conduit or red armored fire alarm cable system depending on the type of construction, see below. All home & main run conduits shall be ¾" pvc coated RGS conduit, branch conduits to devices shall be ½" pvc coated RGS conduit or as required to meet wiring fill per code. All signaling device circuits shall be run in ¾" pvc coated RGS conduit

.3 All bell circuits shall be run separate from device circuits

.4 Color code fire alarm conductors, cables and junction boxes red in color. All junction boxes above ceiling spaces or where exposed shall be painted red in color.

.5 FACP shall be supplied by a separate 120V circuit and connected to an electrical panel closest to the Main Distribution board as practicable. Over current device for the separate circuit supplying the FACP shall be c/w a lock-on device and shall be clearly identified both on the panel & directory.

.6 Seal all penetrations through floors, walls & ceilings with approved fire rated sealant, appropriate for the specific construction assembly, where holes have been drilled for conduits & wiring.

.7 Conductor shall have an insulation rating of not less than 300V and shall not be smaller than as follows:

.1 AC power wiring to FACP shall be #12 AWG RW90 cu. Wire

.2 Bell circuit wiring shall be #12 AWG RW90 cu. Wire

.3 Loop wiring

.1 Integral Assembly type shall be minimum #18 AWG cu. wire, twisted shielded pair cables c/w drain wire.

.2 Individual conductors pulled in raceways shall be minimum #16 AWG cu. Wires.

.4 All wiring & cables shall be FT-4 rated and type approved by the manufacturer and local authorities for its intended use.

.5 All equipment shall be bonded to ground in accordance to code

.8 Wire for connection to base telegraphic alarm loop: No. 12 AWG minimum solid copper conductor.

.9 Insulation 75 degrees C minimum with nylon jacket.

.10 Colour code wiring.

2.11 SURGE SUPPRESSION

.1 Provide line voltage surge suppression devices to suppress voltage transients which might damage control panel components.

2.12 LINE VOLTAGE SURGE SUPPRESSOR

.1 Suppressor : ULC approved with maximum 330 volt clamping level and maximum response time of 5 nanoseconds.

.2 Suppressor: multi-stage construction which includes inductors and silicon avalanche zener diodes.

.3 Equip suppressor with light emitting diode which extinguishes upon failure of protection components.

.4 Fuses: externally accessible.

.5 Wire in series with incoming power source to protected equipment using screw terminations.

.6 Provide surge suppression for circuits which leave building shell.

.7 When circuits interconnect 2 or more buildings, provide arrestor at circuit entrance to each building.

.8 Suppressor: UL 497B listed with maximum 30 volt clamping level and maximum response time of 5 nanoseconds.

.9 Suppressor: multi-stage construction and both differential and common mode protection.

2.13 AS-BUILT RISER DIAGRAM

.1 Fire alarm system riser diagram: in glazed frame, minimum size 600 x 600 mm.

.2 The drawings shall be an electronic version on CD Rom and one set in paper format and shall identify the following

- .1 Layout of equipment
- .2 Zoning
- .3 Complete wiring diagram
- .4 Junction boxes
- .5 Fan shutdown relays
- .6 Isolation Modules
- .7 T-tap locations, if accepted by WSD

2.14 PASSIVE FIRE ALARM GRAPHIC (3 LOCATIONS)

1. Provide a Passive, color CAD drawing indicating the following:
2. Building layout of all floors to include al room numbers,
3. All fire alarm devices including all device addresses as programmed, FACP & annunciator panel locations.
4. "You are here" note.
5. North arrow,
6. Symbol Schedule,
7. Fire Alarm Zone Schedule c/w isolation module locations.
8. Title Block.
9. The Graphic shall be minimum 500mm x 500mm, mounted behind clear Plexiglas, c/w brushed aluminium frame security mounting hardware or mounted in such a way that student can't remove off of wall.
10. Locate Graphic next to FACP and all annunciator panels.
11. Submit to WSD Electrical Designer final accepted Passive Graphic drawing in electronic format (CD) & hardcopy. All drawing rights become the property of the WSD.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install systems in accordance with CAN/ULC-S524

.2 Install main control panel and connect to ac power supply.

.3 Panel to be compatible with existing fire alarm system panel and interconnected as required to provide annunciation in both directions.

.4 Locate and install manual alarm stations and connect to alarm circuit wiring.

.5 Locate and install detectors and connect to alarm circuit wiring. Do not mount detectors within 1 m of air outlets. Maintain at least 600 mm radius clear space on ceiling, below and around detectors. Locate duct type detectors in straight portions of ducts.

.6 Connect alarm circuits to main control panel.

.7 Locate and install horn/strobes and connect to signalling circuits.

.8 Connect signalling circuits to main control panel.

.9 Install end-of-line devices at end of alarm and signalling circuits.

.10 Locate and install remote relay units to control fan shut down. Sprinkler system: wire alarm and supervisory switches and connect to control panel.

.11 Connect fire suppression systems to control panel.

3.3 FIELD QUALITY CONTROL

.1 Site Tests:

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results - for Electrical and CAN/ULC-S537.

.2 Fire alarm system:

.1 Test each device and alarm circuit to ensure manual stations, thermal and smoke detectors and sprinkler systems transmit alarm to control panel and general alarm.

.2 Check annunciator panels to ensure zones are shown correctly.

.3 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of system.

.4 Class B circuits.

.1 Test each conductor on circuits for capability of providing alarm signal on line side of single open-circuit fault condition imposed at electrically most remote device on circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.

.2 Test each conductor on circuits for capability of providing alarm signal during ground-fault condition imposed at electrically most remote device on circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.

.5 Audibility levels of alarm system to be confirmed post occupancy. A proper audiometric report shall be prepared with a calibrated instrument.

.2 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

.3 Verification requirements in accordance with Section 01 47 17 - Sustainable Requirements: Contractor's Verification include:

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

3.4 TRAINING

.1 Arrange and pay for on-site lectures and demonstrations by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system.

.2 Provide the services of a factory-authorized service representative to demonstrate the system and train Owner's maintenance personnel, custodian, etc. as follows;

.1 Train personnel in the procedures and schedules involved in operating, trouble shooting, servicing, and preventative maintenance of the system. Provide a minimum of 8 hours training.
.2 Schedule training with Owner at least seven days in advance.
.3 Provide a type-written instruction sheet in point form indicating simple steps to accessing the system, re-setting & bypassing devices via by-pass switches & individual devices.

3.5 CLEANING

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

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 31 62 13.19 – Precast Concrete Piles

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data: submit manufacturer's printed product literature, specifications and datasheet.

.3 Sub-surface investigation report: when site conditions differ from those indicated, submit written notification to Contract Administrator and await further instructions.

.4 Submit schedule of planned sequence of driving to Contract Administrator for review, as specified.

.5 Spliced piles: when authorized, submit design details of splice complete with signature and stamp of qualified professional engineer registered or licensed in the Province of Manitoba, Canada.

.6 Equipment:

.1 Submit prior to pile installation for approval by Contract Administrator, list and details of equipment for use in installation of piles.

.2 Impact hammers: submit manufacturer's written data as specified.

.3 Non-impact methods; submit characteristics to evaluate performance.

.7 Submit driveability analysis as specified, to Contract Administrator for approval of hammers.

.8 Quality assurance submittals:

.1 Test reports: submit 3 copies of certified test reports for piles from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

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

1.3 DELIVERY, STORAGE AND HANDLING

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

.2 Protect piles from damage due to excessive bending stresses, impact, abrasion or other causes during delivery, storage and handling.

.3 Replace damaged piles as directed by Contract Administrator. Causes for pile rejection are as follows:

.1 Out of fabrication tolerances at time of installation

.2 Cracked, spalled, or broken piles

.3 Out of driving tolerances

1.4 WASTE MANAGEMENT AND DISPOSAL

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

1.5 EXISTING CONDITIONS

.1 Review the Geotechnical Report prior to submitting Bid for the Work.

.2 Notify Contract Administrator in writing if subsurface conditions at Site differ materially from those indicated and await further instructions from the Contract Administrator.

1.6 SCHEDULING

.1 Submit schedule of planned sequence of driving to Contract Administrator for review, not less than two (2) weeks prior to commencement of pile driving.

Part 2 Products

2.1 MATERIALS

.1 Material requirements for piles are specified in Section 31 62 13.19 – Precast Concrete Piles

.2 Supply or fabricate full length piles as indicated and provide equipment to handle full length piles without cutting and splicing.

.3 Do not splice piles without written permission of Contract Administrator. When permitted, provide details for Contract Administrator review. Design details of splice to bear dated seal and signature of Professional Engineer registered in the Province of Manitoba.

Part 3 Execution

3.1 EQUIPMENT

.1 Prior to commencement of pile installation, submit to Contract Administrator for review, details of equipment for installation of piles.

.1 Impact hammers: give Manufacturer's name, type, rated energy per blow at normal working rate, mass of striking parts of hammer, mass of driving cap and type and elastic properties of hammer and pile cushions.

.2 Hammer

.1 Hammers to be selected on basis of driveability analysis using wave equation theory, performed to show that piles can be driven to levels indicated.

.2 The driveability analysis shall include, but not be limited to, the following: hammer, cushion, and capblock details; static soil parameters; quake and damping factors, total soil resistance, blow count, pile stresses, and energy throughput at representative penetrations.

.3 Driveability analysis shall be submitted to the Contract Administrator for review of the hammer or hammers.

.4 When required criteria cannot be achieved with the proposed hammer, use larger hammer and take other measures as required.

.5 Drop hammers are not permitted.

.3 Leads

.1 Construct pile driver leads to provide free movement of hammer. Hold leads in position at top and bottom, with guys, stiff braces, or other means to ensure support to pile while being driven.

.2 Length: provide length of leads so that use of a follower is unnecessary.

.3 Swing leads: firmly guy top and bottom to hold pile in position during driving operation.

.4 Followers: when permitted, provide followers of such size, shape, length, and mass to permit driving pile in desired location to required depth and resistance. Provide followers with socket or hood carefully fitted to top of pile to minimize loss of energy and prevent damage to pile.

3.2 PREPARATION

.1 Ensure that ground conditions at pile locations are adequate to support pile driving operation. Make provision for access and support of piling equipment during performance of Work.

.2 Pre-bore holes to depths indicated in drawings and Geotechnical Report.

.3 Pre-bore with an oversized auger bit to the depths as indicated in the Geotechnical Report.

.4 Prior to starting pile installation, undertake a review of all adjacent infrastructures with the Contract Administrator complete with a photographic record and notes sufficient to establish pre-driving conditions of the existing adjacent infrastructures.

3.3 FIELD MEASUREMENT

.1 Contractor shall cooperate with the Contract Administrator and shall allow access during pile installation operations to facilitate all the field measurements to be performed expeditiously.

.2 Maintain accurate records of driving for each pile, including:

.1 Type and make of hammer, stroke or related energy

.2 Other driving equipment including water jet, driving cap, cushion

.3 Pile size, cast date, batch number or designation, and supply length, location of pile in pile group, location or designation of pile group

.4 Date driven

.5 Sequence of driving piles in grout

.6 Number of blows per 25-mm (1 in.) for last 150-mm (6 in.)

.7 Final tip, cutoff and grade elevations

.8 Re-driving records

.9 Pile plumbness upon completion of driving

.10 Other pertinent information such as interruption of continuous driving and pile damage

.11 Record elevation taken on adjacent piles during, before and after driving of each pile

.12 All measurements, observation and calculations associated with pile driving analyzer and wave equation analysis

.3 Provide Contract Administrator with three (3) copies of records.

3.4 DRIVING

.1 Drive precast piles only when concrete has attained strength as recommended by pile supplier and approved by Contract Administrator; as determined by related concrete compression testing in accordance with CSA A23.2-00.

.2 Use driving caps and cushions to protect piles. Reinforce pile heads as required by Contract Administrator. Piles with damaged heads as determined by Contract Administrator will be rejected.

.3 Hold piles securely and accurately in position while driving.

.4 Deliver hammer blows along axis of pile.

.5 Drive piles to practical refusal, as outlined in the Geotechnical Report. Blow count requirements shall be determined by the Contract Administrator. If followers are used, established criteria for refusal will be increased as determined by the Contract Administrator.

.6 When driving precast concrete piles, adjust hammer, as required, to deliver reduced impact so that reflected tensile stress in pile does not exceed allowable.

.7 Do not drive piles within 10 m of masonry or concrete which has been in place less than seven (7) days. Do not drive piles within 30 m of masonry or concrete which has been in place less than one (1) day.

.8 Re-strike already driven piles lifted during driving of adjacent piles to confirm and assure set.

.9 Remove loose and displaced material from around piles after completion of driving, and leave clean, solid surfaces to receive foundation concrete.

.10 Cut off piles neatly and squarely at elevations as indicated. Provide sufficient length above cut-off elevation so that part damaged during driving is cut off. Do not cut tendons or other reinforcement which will be used to tie supported structure above to pile. A minimum of 450 mm of strands shall remain for this purpose. The cut off surface of the piles shall be mechanically shipped to expose sound concrete.

.11 Remove cut-off lengths from Site on completion of Work.

3.5 DESIGN LOAD CAPACITY

.1 Ultimate Limit States (ULS) and Serviceability Limit States (SLS) design load capacities of piles as indicated in Geotechnical Report.

.2 Installation of each pile will be subject to review of Contract Administrator. Contract Administrator will be sole judge of acceptability of each pile with respect to final driving resistance, depth of penetration, or other criteria used to determine load capacity. Contract Administrator to review final driving of all piles prior to removal of pile driving rig from Site.

3.6 DRIVING TOLERANCES

.1 Pile heads shall be within ± 50 mm of locations as indicated.

.2 Piles shall not to be more than 2 percent of length out of vertical alignment.

3.7 OBSTRUCTIONS

.1 Where obstruction is encountered that causes sudden unexpected change in penetration resistance or deviation from specified tolerances, proceed as directed by Contract Administrator.

3.8 REPAIR/RESTORATION OF REJECTED PILES

.1 The Contract Administrator may require one or more of the following remedial measures in case of rejected piles:

.1 Pull out rejected piles and replace with new piles.

.2 Remove rejected pile and replace with a new, and if necessary, a longer pile.

.3 Remove rejected pile and fill hole as directed by Contract Administrator.

.4 Leave rejected pile in place and cut off as directed by Contract Administrator.

.5 Leave rejected pile in place, place adjacent pile(s), and modify pile cap as directed by Contract Administrator.

.2 No extra compensation will be made for removing and replacing or other Work made necessary through rejection of defective piles.

3.9 PROTECTION

.1 Protect adjacent structures, services, and Work of other Sections from hazards due to pile driving operations.

.2 Arrange sequencing of pile driving operations and methods such that no damage occurs to adjacent existing structures. If damaged, remedy damaged items to restore to original or better condition at own expense.

.3 After the pile driving is complete, undertake a review of the existing adjacent infrastructures with the Contract Administrator to identify any damage to the infrastructures resulting from the pile driving operations.

.4 Protection for pile strand ends:

.1 Highly visible protection safety caps shall be installed for all pile reinforcing strand ends immediately following strand exposure operations. One protection cap may be used for each pile by grouping and securely tying the strands.

.2 The protection caps shall be highly visible and shall be made secure so that accidental contact will not easily dislodge the caps. Dislodged caps shall be re-installed immediately.

.3 Pile reinforcing strands shall be protected from severe bending. Kinked or broken strands shall be repaired to the satisfaction of the Contract Administrator.

3.10 CLEANING

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

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 03 20 00 - Concrete Reinforcing

.2 03 30 00 - Cast-in-Place Concrete

.3 31 61 13 - Pile Foundations, General Requirements

1.2 REFERENCE STANDARDS

.1 ASTM International (ASTM)

- .1 ASTM A 36/A 36M-2004, Standard Specification for Carbon Structural Steel.
- .2 ASTM A 82/A 82M-05a, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
- .3 ASTM A 416/A 416M-05, Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete.
- .4 ASTM A 421/A 421M-05, Standard Specification for Uncoated Stress-Relieved Steel Wire for Prestressed Concrete.
- .5 ASTM A 496/A 496M-05, Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
- .6 ASTM A 572/A 572M-04, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
- .7 ASTM A 615/A 615M-05a, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- .8 ASTM A 706/A 706M-05a, Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.

.2 American Welding Society (AWS)

- .1 AWS D1.4/D1.4M-05, Structural Welding Code - Reinforcing Steel.

.3 CSA Group (CSA)

- .1 CSA-A23.1-19 /A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.
- .2 CAN/CSA-A3000-03(R2005), Cementitious Materials Compendium (consists of A3001, A3002, A3003, A3004 and A3005).
  - .1 CSA-A3001-18, Cementitious Materials for Use in Concrete.
- .3 CAN/CSA-G30.18-09(R2019), Billet-Steel Bars for Concrete Reinforcement.

.4 Precast/Prestressed Concrete Institute (PCI)

- .1 PCI MNL-116-1999, Quality Control for Plants and Production of Structural Precast Concrete Products, 4th Edition.

1.3 MEASUREMENT PROCEDURES

.1 Shoes, pile connectors, cap plates, considered as incidental to supply of piles.

.2 Method 1:

.1 Measure installation of piles in number of piles acceptably installed, including those for test purposes.

.3 Mobilization of equipment: paid as fixed price item.

.4 Actual number and lengths of piles installed established by Contract Administrator from driving records.

.5 Base adjustments in Contract price due to changes in number and lengths of piles on unit prices established in Contract.

.6 Unit of measurement for piles per metre measured from tip elevation to cut-off elevation at pile cap.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product data: submit manufacturer's printed product literature, specifications and datasheet.

.3 Shop drawings: submit shop drawings, each to bear signature and stamp of qualified professional engineer registered or licensed in Province of Manitoba, Canada and include following items:

.1 Lifting point details and locations.
.2 Storage support point locations.
.3 Connector details complete with calculations.
.4 Rock points.
.5 Concrete strength.
.6 Steel grades.
.7 Reinforcing details.
.8 Type and grade of steel.

.4 Show details of driving helmets, cap blocks, and pile cushions.

.5 Quality assurance submittals:

.1 Test reports: submit certified test reports for piles from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
.2 Certificates: submit certificates signed by manufacturer certifying that each batch of piles delivered to site indicating strength.
.3 Instructions: submit manufacturer's installation instructions.
.4 Submit pile driving records as described in PART 3 - DRIVING RECORDS.
.5 Control Plan: submit written report, as described in PART 3 - VERIFICATION, to Contract Administrator verifying compliance that concrete in place meets performance requirements of concrete as established in PART 2 - PRODUCTS.

1.5 DELIVERY, STORAGE, AND HANDLING

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

.2 Ensure handling and installation stresses are within safe limits.

.3 Avoid damage to piles during handling, placing pile in leads, and during pile driving operations.

.4 Support piles laterally during driving, but allow rotation in leads.

.5 Where pile or projecting reinforcement orientation is essential take precautionary measures to maintain orientation during driving.

.6 Square top of pile to longitudinal axis of pile.

.1 Maintain axial alignment of pile hammer with that of pile.

Part 2 Products

2.1 MATERIALS

.1 Cementitious materials: in accordance with Section 03 30 00 - Cast-in-Place Concrete.

.2 Prestressing steel:

.1 Prestressing steel: free of grease, oil, wax, paint, soil, dirt, and loose rust.

.2 Do not use prestressing strands or wire having kinks, bends, or other defects.

.3 Reinforcing steel: to CSA A23.1/A23.2, CAN/CSA-G30.18 and in accordance with Section 03 20 00 - Concrete Reinforcing, weldable, 400 MPa yield.

.4 Ties: in accordance with ASTM A 615/A 615M.

.5 Spirals: in accordance with ASTM A 82/A 82M ASTM A 496/A 496M.

.6 Provide appropriate anchorages and end fittings.

.7 Pile connections: capable of providing positive means to hold pieces together, maintaining alignment for full depth and transmitting full design load.

2.2 CONCRETE MIXES

.1 Alternative 1 - Performance Method for specifying concrete: to meet Contract Administrator performance criteria in accordance with CAN/CSA-A23.1/A23.2

.1 Ensure concrete supplier meets performance criteria as established below and provide verification of compliance as described in PART 3 - VERIFICATION.

.2 Provide concrete mix to meet following hard state requirements:

.1 Durability and class of exposure: S-2

.2 Minimum compressive strength at 28 age: 35MPa or as recommended by pile supplier and approved by Contract Administrator, whichever is higher.

2.3 FABRICATION

.1 Fabricate precast concrete piles as indicated.

.2 Fabricate piles to following finish tolerances:

.1 Length: plus or minus 3 mm/m of length.

.2 Cross section:

.1 Wall thickness of hollow sections: minus 5 to plus 10 mm.

.2 Solid sections: minus 5 to plus 10 mm.

.3 Deviation from straight line: not more than 3 mm/m of length, 10 mm in full length.

.4 Deviation of internal core or void from true position: 10 mm.

.5 Pile head: 10 mm/m from true right angle plane.

.1 Surface irregularities 3 mm.

.6 Location of reinforcing steel main reinforcing cover: minus 3 to plus 5 mm; spiral: 10 mm.

.3 Quality and dimensions of piles will be determined by Contract Administrator.

.1 Remove rejected piles from site.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PILE HAMMERS

.1 Use hammer capable of developing indicated ultimate pile capacity considering hammer impact velocity; ram weight; stiffness of hammer and pile cushions; cross section, length, and total weight of pile; and character of subsurface material encountered.

.2 Use heavy ram and short stroke with low impact velocity, except for diesel hammers, to obtain required driving energy of hammer.

.3 At final driving:

.1 Operate pile hammer in accordance with manufacturer's recommendation for driving either end bearing piles or friction piles.

.2 Operate diesel powered hammers at rate recommended by manufacturer for hard driving.

.4 Maintain pressure at steam or air hammer:

.1 For double-acting hammer: number of blows per minute during and at completion of driving of pile is equal to that at which hammer is rated.

.2 For single-acting hammer: there is full upward ram stroke.

.3 For differential type hammer: there is slight rise of hammer base during each upward stroke.

3.3 PREDRILLING OF PILES

.1 Hole diameter not to exceed two-thirds of pile width.

.2 Predrill only to depth of 3 meters below cut-off elevation prior to setting piles. Longer predrill lengths subject to approval of Contract Administrator.

3.4 INSTALLATION

.1 Install piles in accordance with Section 31 61 13 - Pile Foundations, General Requirements.

.2 Splice piles as indicated on approved shop drawings.

3.5 PILE CUT-OFF

.1 Cut-off piles with smooth, level cut using pneumatic tools, sawing, or other suitable methods approved by Contract Administrator.

.2 Use of explosives for cutting is not permitted.

.3 Remove cut-off sections of piles from site upon completion of work.

3.6 PILE RECORDS

.1 Keep complete and accurate record of each pile driven.

.2 Indicate pile location, deviations from pile location, cross section shape and dimensions, original length, ground elevation, tip elevation, cut-off elevations, number of blows required for each 300mm of penetration and number of blows for last 150 mm of penetration as required for "calculated" driving resistance.

.3 Include in record beginning and ending times of each operation during driving of pile, type and size of hammer used, rate of operation, stroke or equivalent stroke for diesel hammer, type of driving helmet, and type and dimension of hammer cushion (capblock) and pile cushion used.

.4 Record retap data and unusual occurrences during pile driving such as redriving, heaving, weaving, obstructions, jetting, and driving interruptions.

3.7 FIELD QUALITY CONTROL/ VERIFICATION

.1 Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established in Part 2 - Products, by Contract Administrator and provide verification of compliance as described in PART 1 - QUALITY ASSURANCE

3.8 CLEANING

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

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 DESCRIPTION

.1 Work includes, but is not necessarily limited to the following items

.1 Supply and installation of railway embankment materials between Sta 2+033.21 – 2+178.81

.2 Supply and Installation of 150mm diameter subdrains between Sta 2+063.71 – 2+157.

.3 Supply and installation of (2) – 1.2m diameter CBMH at Sta. 2+150.

.4 Supply and Installation of 8.5m long 300mm diameter concrete storm sewer at Sta. 2+150.

.5 Excavation and backfilling.

.6 Disposal off-site of all excavated materials.

.7 Removal of 67m of existing 100lb bolted track on track 2.

.8 Removal of existing Fixed Bump Post at end of track 2.

.9 Supply and installation of rails, ties, other track material (OTM), and ballast for new 115lb bolted track.

.10 Ballasting and surfacing of new track construction and existing turnout.

.11 Supply and installation of Fixed Bumping Post at end of track Station 2+177.81.

.12 General cleanup.

1.2 RELATED REQUIREMENTS

.1 City of Winnipeg Specification CW1110 – General Instructions

.2 City of Winnipeg Specification CW1120 – Existing Services, Utilities, and Structures

.3 City of Winnipeg Specification CW1130 – Site Requirements

1.3 REFERENCE STANDARDS

.1 American Railway Engineering and Maintenance of Way Association (AREMA)

.1 AREMA Manual for Railway Engineering – Latest Edition.

.2 ASTM International (ASTM)

.1 ASTM C 117-04, Standard Test Method for Materials Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.

.2 ASTM C 136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.

.2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Safety Data Sheets (SDS).

.5 City of Winnipeg Standard Construction Specifications

.6 NEWPCC Interim Phosphorous Removal Geotechnical Foundation and Environmental Assessment by KGS January 31, 2022.

.7 CP Engineering Guidelines for Private Siding Design and Construction June 2017.

.8 CP Red Book of Track and Structures, Latest Edition.

.9 CPR Guidelines for excavations on CPR property March 8, 2012.

1.4 MEASUREMENT AND PAYMENT PROCEDURES

.1 Measurement

.1 Measure clearing and grubbing under CW 3010 – Clearing and Grubbing.

.2 Measure railway subgrade grading and embankment works under CW 3110 – Sub-Grade, Sub-Base, and Base Course Construction.

.3 Measure common excavation – unsuitable under CW3170 – Earthwork and Grading.

.4 Measure supply and installation of geotextiles under CW3130 – Supply and Installation of Geotextiles Fabrics.

.5 Measure supply and installation of geogrid under CW3135 – Supply and Installation of Geogrid.

.6 Measure seeding and topsoil placement under CW3520 – Seeding.

.7 Measurement of off-site disposal of unsuitable materials under E10 - Subsurface Characterization.

.8 Measure supply and installation of sub-ballast in tonnes of material supplied and incorporated into the Work.

.9 Measure supply and installation of subdrains under CW 3120 – Installation of Subdrains.

.10 Measure supply and installation of cleanouts per each cleanout installed.

.11 Measure supply and installation of concrete storm sewer under CW2130 – Gravity Sewers.

.12 Measure supply and install of catch basin manholes under CW2130 – Gravity Sewers.

.13 Measure new track construction in metres of track along centreline of completed track from last switch tie to end of track, include rails, ties, joints and spikes.

.14 Measure track removal in metres of track along centreline of existing track from last switch tie to end of track, include rails, ties, joints, and spikes.

.15 Measure removal of existing bumping post as lumps sum including connecting rails and fasteners.

.16 Measure supply and installation of ballast in tonnes supplied and incorporated into the Work.

.17 Measure new track construction surfacing in metres along centreline of completed track.

.18 Measure existing turnout ballasting and surfacing as lump sum.

.19 Measure installation of Fixed Bumping Post as lump sum.

.20 Measure off-site disposal of track material removal as lump sum.

.2 Payment

.1 Payment for clearing and grubbing under CW 3010 – Clearing and Grubbing.

.2 Payment for railway grading and embankment works under CW 3110 – Sub-Grade, Sub-Base, and Base Course Construction.

.3 Payment for common excavation – unsuitable under CW3170 – Earthwork and Grading.

.4 Payment for supply and installation of geotextiles supply and installation of geotextiles under CW3130 – Supply and Installation of Geotextiles Fabrics.

.5 Payment for supply and installation of geogrid under CW3135 – Supply and Installation of Geogrid.

.6 Payment for seeding and topsoil placement under CW3520 – Seeding.

.7 Payment for off-site disposal of unsuitable materials under E10- Subsurface Characterization.

.8 Payment for the supply and installation of sub-ballast in tonnes will be paid by each truck ticket of load material incorporated into the Work verified by the Contract Administrator.

.9 Payment for supply and installation of subdrains under CW 3120 – Installation of Subdrains. Payment will include the supply and installation of the drainage materials and drainage fabric.

.10 Payment for supply and installation of cleanouts will be at the Contract Unit Price for each cleanout installed. Unit price includes, but is not limited to, trench excavation, furnishing and placing backfill material, and geotextile fabric

.11 Payment for supply and installation of concrete storm sewer under CW2130 – Gravity Sewers. Unit price includes, but is not limited to, trench excavation, furnishing and placing bedding and backfill material.

.12 Payment for new track construction will be at the Contract Unit Price in metres of track along centreline of completed track from last switch tie to end of track, include rails, ties, joints, and spikes.

.13 Payment for track removal will be at the Contract Unit Price in metres of track along centreline of existing track from last switch tie to end of track, include rails, ties, joints, and spikes.

.14 Payment for removal of existing bumping post as lump sum including connecting rails and fasteners.

.15 Payment for supply and installation of ballast in tonnes will be paid by each truck ticket of load material incorporated into the Work verified by the Contract Administrator.

.16 Payment for new track construction ballast and surfacing will be at the Contract Unit Price in metres along centreline of completed track.

.17 Payment for existing turnout ballasting and surfacing in lump sum.

.18 Payment for Fixed Bumping Post as lump sum.

.19 Payment for off-site disposal of track removal materials as lump sum.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with CW 1110 – General Instructions.

.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 Quality assurance submittals: submit following in accordance with CW 1110 – General Instructions.

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

1.6 QUALITY ASSURANCE

.1 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section and on-site installation, with 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 manufacturer's installation instructions and warranty requirements.

.2 The Contractor shall be responsible to conduct their own Quality Assurance to ensure all material; workmanship, etc. meet the requirements of the Contract Documents. The Contractor shall provide their own Track Specialist to inspect the track and confirm that the track is suitable for operation of train traffic at the authorized speed for each track section disturbed by construction activities.

.3 The Contractor shall provide a Site-Specific Quality Assurance Plan outlining method and frequency of tests, to the Contract Administrator for approval prior to start of the Works, based on the following minimum requirements:

.1 Management responsibilities specific to the Contract including the responsibility and authority for quality.

.2 Organization proposed for the Contract.

.3 Site management and supervision.

.4 Qualifications and competencies including current qualifications of all key staff, including Subcontractors, proposed to be used on the Agreement.

.1 Track Specialist/Inspector: Qualified Track Inspectors shall have at least two (2) years of satisfactory related experience inspecting, constructing, or maintaining track. They shall possess a combination of experience in track maintenance and training received from a qualified course in track inspection or from a college level education program related to track inspection and hold a valid Track Inspection Guidelines (TIG) Inspectors Card. Track Inspectors shall also be Canadian Rail Operating Rules (CROR) qualified and shall be physically capable of performing duties of a Track Inspector.

.5 Contractor’s method of control of Sub-contract Works and quality

.6 All work processes and equipment for all construction Works

1.7 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling, and unloading:

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

.2 Materials shall be handled in a manner to prevent damage to any of the materials.

.3 Equipment used shall be of proper type and capacity for the intended purpose and shall conform to all Provincial Government Occupational Health & Safety (OH&S) standards.

.4 Individual pieces of rail shall be moved using rail tongues. Dragging rail is not acceptable.

.5 If, in opinion of the Contract Administrator, materials become damaged during transportation or handling and can no longer meet the specified requirements, the Contractor shall immediately remove the material from site and replace the materials at no additional cost to the City.

.2 Storage and Protection:

.1 Stack rails head up and with proper support to prevent bending.

.2 Store ties by stacking. Stack ties so that bottom ties are at least 150 mm clear of ground and supported on sills.

.3 Store small materials in original wrappings or containers until required for use.

.4 Track materials stored onsite shall not be driven over by equipment under any circumstances, as this practice may result in unnecessary damage.

Part 2 Products

2.1 MATERIALS

.1 Granular materials shall be in accordance with CW 3310 – R21 Sub-Grade, Sub-Base and Base Course Construction and CW2030 – Excavation Bedding and Backfill

.1 Gradations: within limits specified when tested to ASTM C 136 and ASTM C 117.

.1 Sieve sizes to CAN/CGSB-8.1 and CAN/CGSB-8.2.

2.2 TRACK SUB-BALLAST

.1 Track sub-ballast is to meet the following requirements:

.1 Crushed gravel or crushed stone with a minimum 75% of material having two fractured faces. It shall consist of hard, durable, angular particles, free from soft, thin, elongated, or laminated particles, organic material, clay lumps or minerals, frozen material or other substances that would act in deleterious manner for use intended. Sub-ballast shall meet the quality requirements of ASTM Standard D1241.

.2 Gradation:

Sieve Size	Percent Passing (by weight)
50 mm	100
25 mm	90-100

Sieve Size	Percent Passing (by weight)
15 mm	50 – 80
2 mm	25 – 50
0.425 mm	12 - 30
0.075 mm	0 - 5

.3 Contractors shall base their proposal prices on above noted criteria but are encouraged to submit alternate proposals for sub-ballast, including proposed material gradation, subject to approval by the Contract Administrator.

2.3 BORROW

.1 Borrow for subgrade construction is to meet the following requirements:

.1 Gradations: in accordance with the Granular A Base Course on Table CW 2110.1 of CW 3310 – Sub-grade, Sub-base, and Base Course Construction.

2.4 BEDDING

.1 Bedding for sewer construction is to meet the following requirements:

.1 Gradation: in accordance with Type 2 sand material on Table CW 2030.1 of CW2030 – Excavation Bedding and Backfill.

2.5 GEOSYNTHETICS

.1 Geosynthetics is to meet the following requirements:

.1 Geotextiles for material separation: in accordance with CW 3130 – Supply and Installation of Geotextiles Fabrics.

.2 Geogrid: in accordance with CW3135 – Supply and Installation of Geogrid.

2.6 STORM SEWER PIPE

.1 Concrete pipe for storm sewer construction is to meet the following requirements:

.1 Approved Products: in accordance with CW 2130 – Gravity Sewers Section 2.1.

.2 Conform with the City of Winnipeg Standard Construction Specification CW 2130 – Gravity Sewers Section 2.1 – 2.5.

2.7 SUBDRAINS

.1 Subdrains for drainage construction is to meet the following requirements:

.1 Approved Products: in accordance with CW 3120 – Installation of Sub Drains Section 2.1.

.2 Drainage Materials: in accordance with CW 3120 – Installation of Sub Drains Section 2.3.

.3 Drainage Pipe: in accordance with CW 3120 – Installation of Sub Drains Section 2.3.

.4 Pipe Appurtenances: in accordance with CW 3120 Installation of Sub Drains Section 2.5.

2.8 CLEANOUTS

.1 Cleanouts for drainage construction is to meet the following requirements:

.1 Use solid wall PVC riser pipe and fitting of the same diameter as the adjacent subdrain.

.2 Material specifications in accordance with CW 3120 – Installation of Sub Drains Section 2.4.

2.9 PRECAST CONCRETE CATCH BASIN MANHOLES

.1 Precast concrete catch basin manholes are to meet the following requirements:

.1 Approved Products: in accordance with CW 2130 – Gravity Sewers Section 2.1.

.2 Catch basins covers: in accordance with CW 2130 – Gravity Sewers Section 2.7.

.3 Precast concrete manholes: in accordance with CW 2130 – Gravity Sewers Section 2.7.

.4 Fasteners: in accordance with CW 2130 – Gravity Sewers Section 2.8.

.5 Cast-in-Place Concrete, Grout, Mortar and Cement-Stabilized Fill: in accordance with CW 2130 – Gravity Sewers Section 2.9.

.6 Cement Patching: in accordance with CW 2130 – Gravity Sewers Section 2.10

2.10 BALLAST

.1 Ballast is to meet the following requirements:

.1 Crushed stone consisting of hard and durable particles free from deleterious substances.

.2 The type and gradation of ballast material shall comply with AREMA Specification Grade 4.

2.11 RAILWAY TIES

.1 Railway ties are to meet the following requirements:

.1 Wood ties shall be new 7" x 9" x 8.5' track ties. All ties shall be #1 hardwood grade ties, treated with a creosote-coal tar solution to a new retention of 9.2 lbs per cubic foot minimum for mixed hardwoods. Wood ties shall conform to current AREMA Specifications, Chapter 30 "Ties", for size, quality, treatment, and defects. Bore holes for spikes before preservative treatment application.

.2 No ties will be accepted with the following defects:

.1 Broken Ties: tie which is broken through the entire depth of the tie.

.2 Split tie - tie split end to end for the entire depth of the tie.

.3 Split tie end - tie end split resulting in poor surface and gauge.

.4 Cut tie - tie which is rail or plate cut or adzed to a depth of 2 inches or more on No.1 ties, or more than 1 inch on No.2 ties.

.5 Crushed tie - tie which has the bearing surface under the rail crushed one inch or more deep to the extent it cannot hold surface, line, or gauge.

.6 Spike killed tie - condition is indicated by numerous splits at the tie end and/or high spikes, wide gauge, and poor alignment.

.7 Decayed Tie - tie which is rotted, hollowed, or deteriorated and cannot hold spikes, gauge, or surface.

.8 Damaged Tie - tie which is damaged to a depth of 2 inches or more due to derailments, dragging equipment or fire.

.9 Worn tie - tie that is worn or rounded on the bottom resulting in poor surface and line or the inability to hold spikes

2.12 RAIL

.1 Rail is to meet the following requirements:

.1 Rail shall be new or previously worn 115lb jointed. All rail shall be free of physical defects, control cooled, straight, free of kinks and be in compliance with current AREMA Specifications, Chapter 4 and the CP Industrial Standards.

.2 All rails shall be in standard 39’ lengths or longer unless tying into a turnout or other obstruction in which case no rail shall be shorter than 19 feet. Rail less than 39 feet may not make up more than 25% of the total rails.

2.13 OTHER TRACK MATERIALS (OTM)

.1 Other track materials (OTM) are to meet the following requirements:

.1 Rail anchors: shall be new or manufacturer certified refurbished, drive-on-type and of standard manufacture, as approved by the City, of the proper size to fit 115lb rail sections.

.2 Tie plates: shall be new or PW and measure a minimum of 7.5" x 14" for 5.5" base of rail on tangent and curves up to 7 degrees 30 minutes. Curves 7 degrees 30 minutes and over shall be rolled plates complete with screw spikes and clips. All non-rolled tie plates shall have 6 spike holes. All tie plates are to be double shoulder with 1:20 cant, free of injurious defects and foreign material, and shall conform to current AREMA Specifications for 115lb rail. Plates must have the

correct punching to fit the base of rail used. No tie plates with slotted holes will be permitted.

.3 Joint bars: shall be new or previously worn, toeless type, free of foreign material and without injurious defects. They shall confirm to current AREMA Specifications and must be to the proper design and dimensions for the rail on which it is to be applied. 115lb joint bars and 100lb – 115lb compromise joint bars shall have 4 or 6 bolt holes.

.4 Track spikes: shall be new 5/8" square with reinforced throat design. All track spikes shall confirm to current AREMA Specifications for High-Carbon Steel Track Spikes, Chapter 5, Part 2. Length of track spike under its head shall be 6".

.5 Screw spikes: shall new and free of any defect and conform to standards of Canadian Pacific Railway.

.6 Clips: shall be new and free of any defects and conform to standards of Canadian Pacific Railway.

.7 Track bolts, nuts, and lock washers: shall new be new. Bolts and nuts shall conform to current AREMA Specifications. Bolts and nuts shall be to the appropriate size for the bolt holes in the rail section with length sufficient for a full nut and lock washer and 1/4" thread exposed. Lock washers of the appropriate size to fit the track bolt used shall conform to current AREMA Specifications. Each track bolt shall receive one lock washer.

2.14 BUMPING POST

.1 Bumping post is to meet the following requirements:

.1 Bumping posts shall be Fixed Bumping Post to suit AAR coupler as manufactured by Hayes model WD or approved equivalent.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 DEFINITIONS

.1 See CW 3110 – Sub-Grade, Sub-Base, and Base Course Construction Section 1.2 for classification of railway embankment materials.

3.3 PROTECTION OF EXISTING FEATURES

.1 Existing buried utilities and structures:

.1 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.

.2 Prior to commencing excavation work, notify Authorities having jurisdiction, establish location and state of use of buried utilities and structures. The Contract Administrator or authorities having jurisdiction shall clearly mark such locations to prevent disturbance during work.

.3 Confirm locations of buried utilities by careful test excavations.

.4 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered. Obtain direction of the Contract Administrator before moving or otherwise disturbing utilities or structures.

.5 Record location of maintained, rerouted, and abandoned underground lines.

.6 Protect existing trees, landscaping, survey control points & benchmarks, buildings, pavement, signage, signals, etc. which are to remain. If damaged, restore to original or better condition unless directed otherwise.

3.4 STRIPPING OF TOPSOIL

.1 Complete topsoil stripping activities in accordance with CW 3110 – Sub-Grade, Sub-Base, and Base Course Construction Section 3.2.4 unless noted otherwise in this section.

.1 Removal the surficial topsoil, and organics along the length of the proposed new rail line, with an average thickness of 0.3 m.

3.5 EXCAVATION

.1 Complete excavation activities in accordance with CW 3110 – Sub-Grade, Sub-Base, and Base Course Construction Section 3.2 unless noted otherwise in this section.

.1 Sub-excavate the clay fill and clay subgrade, observed from Sta. 0+080 to the proposed railcar shelter 2, a minimum of 300 mm.

3.6 EMBANKMENTS

.1 Complete embankment construction activities in accordance with CW 3110 – Sub-Grade, Sub-Base, and Base Course Construction Section 3 unless noted otherwise in this section.

.2 The subgrade should be sub-excavated to the design elevation and proof-rolled to achieve a minimum compaction of 98% SPMDD. The subgrade should be proof rolled using a heavy sheepsfoot roller for the clay subgrade and smooth drum roller for the granular subgrade.

.3 If any soft spots are encountered in the subgrade, they should be sub excavated 600 mm and backfilled with compacted granular fill to 98% SPMDD.

.4 A non-woven geotextile fabric should be placed as a separator between the clay and compacted granular material.

.5 All granular backfill material should be placed in maximum 150 mm thick lifts and compacted to 100% SPMDD.

.6 The side slopes of the embankment should be a graded to a slope no steeper than 2H:1V, and no benching is required for slopes less than 2 m in height.

.7 Finished subgrade, ditches, and slopes to be within 15 mm of design as indicated but not uniformly high or low.

3.7 SUBDRAINS

.1 Install subdrains in accordance with CW 3120 – Installation of Subdrains Section 3.1 – 3.4.

3.8 CLEANOUTS

.1 Install cleanouts in accordance with the details shown on drawing number 1-0101-CGAD-F204-001.

3.9 STORM SEWER PIPE

.1 Install sewer pipe in accordance with CW 2130 – Gravity Sewers Section 3.8.

3.10 PRECAST CONCRETE CATCH BASIN MANHOLES

.1 Install pre-cast concrete catch basin manholes in accordance with CW 2130 – Gravity Sewers Section 3.1 – 3.7.

3.11 SUB-BALLAST

.1 Install sub-ballast in accordance with Clause 3.11 -3.13 of this Section unless noted otherwise.

.1 Finished sub-ballast to be within 15 mm of design as indicated but not uniformly high or low.

3.12 HANDLING AND STOCKPILING EARTHWORKS

.1 Handle and transport aggregates to avoid segregation, contamination, and degradation.

.2 Stockpile aggregates off site, or where directed by the Contract Administrator.

.3 Stockpile aggregates in sufficient quantities to meet project schedules.

.4 Stockpiling sites to be level, well drained, and of adequate bearing capacity and stability to support stockpiled materials and handling equipment.

.5 Separate different aggregates by strong, full depth bulkheads, or stockpile far enough apart to prevent intermixing.

.6 Do not use intermixed or contaminated materials. Do not incorporate bottom 300 mm of stockpile into work. Remove and dispose of rejected materials as directed by the Contract Administrator within 48 hours of rejection.

3.13 PLACING EARTHWORKS

.1 Place granular, sub-ballast or backfill, as indicated on drawings.

.2 Place granular after subgrade is inspected and approved by the Contract Administrator.

.3 Construct granular to depth and grade in areas indicated.

.4 Ensure no frozen material is placed.

.5 Place material only on clean unfrozen surface, free from snow or ice.

.6 Place materials using methods that do not lead to segregation or degradation.

.7 For spreading and shaping material, use spreader boxes having adjustable templates or screens which will place material in uniform layers of required thickness.

.8 Place material to full width in uniform layers not exceeding 150 mm compacted thickness.

.9 Shape each layer to smooth contour and compact to the specified density before succeeding layer is placed.

.10 Remove and replace portion of layer in which material has become segregated during spreading.

.11 Do not place sub-ballast until structures under and alongside tracks have been completed and required grading, ditching and sub-drain work is completed in track area.

.12 Spread sub-ballast material so as not to mix with subgrade or become contaminated with deleterious substances.

.13 Place sub-ballast by means which will not leave ruts in subgrade below sub-ballast.

3.14 STOCKPILING AND SURPLUS MATERIAL

.1 Stockpile fill materials suitable for reuse in grading only in areas designated on drawing or as directed by the Contract Administrator.

.2 Unsuitable or excess material shall be disposed of off site. Disposal of Material to conform to CW 3170 – Earthwork and Grading Section 9.4. Materials to be tested for contamination shall be in accordance to E10 - Subsurface Characterization.

3.15 DEWATERING

.1 Complete ditch excavation as far as practical in advance of embankment construction unless otherwise approved by the Contract Administrator.

.2 Keep excavations free of water while work is in progress.

.3 Protect open excavations against flooding and damage due to surface run off.

.4 Dispose of water in a manner not detrimental to public and private property, or any portion of work completed or under construction, and in conformance to all environmental regulations.

.5 Continuously dewater the excavations to control surface runoff or perched water table seepage for concreting and other work to be carried out in the dry condition.

.6 Submit for Contract Administrator's review details of proposed dewatering methods, such as dikes or well points.

3.16 INSPECTION AND TESTING

.1 Testing of on-site materials and compaction will be carried out by the Contractor. Frequency of tests will be determined by the Contract Administrator.

.2 The Contractor shall submit test results for Earth Borrow and Sub-ballast materials prior to placement of the material in the Work. When more than one source is used for the supply of the material, test data from each source shall be managed independently.

.3 Track material furnished shall be presented for inspection in reasonable quantity to and size.

.4 Present to the Contract Administrator written notice for track material inspection at least 7 days in advance of availability for inspection.

3.17 PROTECTION

.1 Maintain finished subgrade in condition conforming to this section until succeeding sub-ballast course is constructed, or until granular sub-ballast is accepted by the Contract Administrator.

.2 Repair any damage to completed subgrade prior to placing sub-ballast, all to the satisfaction of the Contract Administrator.

3.18 COMPACTION

.1 Complete compaction activities in accordance with CW 3170 – Earthwork and Grading Section 9.7 unless noted otherwise in this section.

.1 Compaction in accordance with ASTM D698 and ASTM D1557.

.1 Granular materials: Compact to density of not less than 100% SPMDD.

.2 Sub-excavation: Compact backfill materials to density of not less 98% SPMDD.

3.19 GEOTEXTILES

.1 Place geosynthetic material in accordance with CW 3130 – Supply and Installation of Geotextiles Fabrics Section 3.

3.20 GEOGRID

.1 Place geogrid material in accordance with CW 3135 – Supply and Installation of Geogrid Section 3.

3.21 RAILWAY TIES

.1 Ties shall be installed in accordance with CP Engineering Guidelines for Private Siding Design and Construction.

.2 The cross ties shall be placed on the approved finished sub-ballast, perpendicular to center line of track, with the right hand (in the direction of increasing stationing) ends of cross ties being the same distance from center line of track, except on curves, where cross ties are to be aligned to the inside of the curve.

.3 All rail joints/welds are to be suspended between ties.

.4 Track shall be constructed with maximum 559mm (22.0”) tie spacing center to center. Fill unused spike holes with tie plugs.

.5 The top surface of timber ties shall be clean and smooth to provide full bearing for tie plates. The bottom of the rail, the tie plate, and the wearing surface of the timber tie shall be broom cleaned before the rail is laid.

.6 Treated ties must not be handled with any tool having sharp points that will penetrate beyond the depth of the treatment or cause damage to the ties.

.7 Plug all spike holes when re-spiking and fill unused spike holes with an epoxy-based filler or approved equivalent.

3.22 LAYING RAIL

.1 Rail shall be laid in accordance with AREMA Manual for Engineering.

.2 Use rail saws and rail drills only for cutting and drilling rail respectively. Do not use welding equipment to cut rail or drill holes in rail, under any circumstances.

.3 Rails must be handled carefully at all times. It should be unloaded by use of a crane, skids or threader and must not be dropped. Rail must not be struck with a steel hammer or similar tool.

.4 Do necessary gauging at time rail is laid. The right-hand rail facing in direction of increasing construction shall be spiked to ties, and the opposite rail shall be brought to gauge of 4' 8-1/2" (1435mm), measured at right angles between the rails, in a place 5/8" (15.9mm) below top of rail. A track gauge manufactured for the purpose of measuring gage should be used rather than a tape measure. Gauge is to be checked at every third tie. Do not strike rail directly with a maul, either on top when driving spikes, or on side to obtain track gage.

.5 Lay rails with staggered joints, the stagger between joints in opposite rails being not less than 12 feet except as otherwise authorized by the Contract Administrator. Use short rails in the inside line of rails on curves of a large central angle when required to keep the joints within the permissible limit of variation.

.6 When placing rail, slide into position using pinch bars or lining bars or lift with rail tongs. Do not move rail into position by driving with hammer or other tools or butting with another rail.

.7 Avoid mixing rails of different manufacturers wherever possible.

.8 Where new rail adjoins second-hand rail the maximum mismatch shall not exceed 6.4mm (1/4"). Where required, mismatch shall be reduced through welding, grinding or replacement of the rail, as directed by the Contract Administrator.

3.23 RAIL JOINTS

.1 Apply an approved lubricant to the fishing spaces of the bar and rail before placing joint bars.

.2 Place joint bars and tighten bolts in the recommended pattern before spiking the rail.

.3 All drilled holes shall be deburred.

.4 All rail joints shall be fully bolted.

.5 Bolts in the rail joint shall be tightened to the following torque:

Bolt Torques

Size of Bolt	Torque (FT. LB.)
1”	550
7/8”	450

.6 Couple rail of different weights and sections with appropriate compromise joints in manner similar to other rail joints.

3.24 RAIL EXPANSION

.1 Provide the proper space allowance for expansion by placing shims of metal, fiber, or wood between the ends of the adjoining rails as each rail is laid, except at insulated joints These shims must be left in place until the line of rail is fully bolted and spiked. If rail anchors are provided, do not remove the shims until the rail line is anchored at least 10 rail lengths beyond the joint.

.2 The following table shows the expansion allowances for various lengths of rail at different rail temperatures (in degrees Fahrenheit):

LENGTH OF RAIL IN FEET	EXPANSION ALLOWANCE (INCHES)					
	0	1/16	1/8	3/16	1/4	5/16
30 to 39	Above 85° F	65° to 85° F	40° to 64° F	20° to 39° F	0° to 19° F	Below 0° F
60 to 90	Above 85° F	74° to 85° F	61° to 73° F	48° to 60° F	35° to 47° F	Below 35° F

3.25 SPIKING

.1 Spiking of track shall be in accordance with CP Engineering Guidelines for Private Siding Design and Construction.

.2 Space ties properly and square to the rail before driving spikes.

.3 When spiking, maintain uniform track gauge, within permissible tolerance.

.4 Start and drive spikes vertically, and square, to provide a full bearing against the edge of the base of the rail.

.5 Spikes must be driven so that a 1/8" (3.2mm) space is left between the underside of the head of the spike and the top of the base of the rail. Do not overdrive or straighten spikes while being driven. Do not strike the rail when driving spikes.

.6 On tangent, four spikes shall be used on each tie plate; on curves, two degrees to eight degrees, six spikes, two on the outside and two on the inside of each rail; and on curves above eight degrees, eight spikes, two on the outside and two on the inside of each rail shall be used.

.7 Spikes shall not be placed less than two inches from edge of the tie. The spikes shall be staggered so that the outside spikes in each tie will be near the same edge of that tie, and the inside spikes near the opposite edge with the position of the spikes the same on all ties.

3.26 TIE PLATES

.1 Double-shoulder tie plates will be used on all ties and set in position with cant surface sloping inward, making sure they are firmly seated and have full bearing.

.2 After rails are in place the shoulder of plates shall be in full contact with outside edge of rail base.

3.27 BALLASTING, SURFACING, AND LINING

.1 Ballasting shall be performed in accordance with the CP Engineering Guidelines for Private Siding Design and Construction. Unload and level down ballast by most practical means.

.2 Ballast shall be placed as indicated on the drawings and/or as directed by the Contract Administrator.

.3 Before commencing ballasting or surfacing, the Contractor shall line the track to within 25mm (1”) of final horizontal alignment, and ties shall be spaced in accordance with Contract Specifications.

.4 Perform tamping, using power tamping machines wherever possible, or manually, using approved AREMA tamping tools appropriate for type of ballast being placed when machines are not possible such as in switch points

.5 Ballasting shall be performed in lifts not exceeding 4” (100mm). Lift both rails simultaneously and as uniformly as possible.

.6 The ballast section shall be a minimum of 310mm below bottom of tie. The ballast shall also extend level 1 foot beyond the ends of the ties before breaking to a maximum 2:1 slope. All tie cribs shall be filled to top of tie. If track centers are less than 18 ft (5.5 m) center to center, the entire space between the tracks shall be filled to top of tie with ballast.

.7 Tamp each layer of ballast from a line 15" (381mm) inside each rail, on both sides of and to the ends of ties. Center area between these limits shall be filled lightly with ballast but not tamped.

.8 At turnouts, tamp ballast uniformly for full length of ties. Tamping shall proceed simultaneously at both ends of same tie, making sure ballast is forced directly under the ties and against sides and ends of ties.

.9 The Contractor shall lift, line, and tamp the track to within 25mm (1") of final top of rail elevations, in preparation for final surfacing.

.10 The Contractor, at their sole discretion, may pre-ballast and compact ballast prior to constructing track.

3.28 FINAL SURFACING

.1 The finished ballast section shall be shaped as shown on the drawings.

.2 The Contractor shall shape the ballast section in conformance with the planned drawings and shall include any ballasting required to fill tie cribs and shoulders.

.3 Manual tamping and lifting of turnouts or isolated sections of new track shall be considered integral to the Work.

3.29 RAIL ANCHORS

.1 Rail anchors shall be installed in conformance with the pattern as shown in the CP Red Book of Track & Structures Requirements, Appendix 9 – Anchoring Patterns Bolted and CWR.

.2 Rail anchors must only be applied to the rail section for which they are designed. Apply and remove rail anchors with the proper tools. When applying anchors by mechanical means, ensure the machine is properly adjusted.

.3 To avoid tie skewing, install rail anchors in the same direction, against the same tie on the opposite rail.

.4 Apply rail anchors on the gauge side of the rail and with full bearing against the tie or tie plate and ensuring that they are not overdriven.

.5 Do not apply rail anchors where they will interfere with bond wires, insulated joints or other signal or track appliances.

.6 Install the number and distribution of anchors as follows:

.1 16 per 39-foot rail box anchored shall be used on all tracks.

.2 Additional rail anchors or change in anchor pattern may be required on some installations.

.7 Rail anchors shall be of a drive on type so that they can be applied and removed without a special tool.

3.30 FINAL ALIGNMENT AND COMMISSIONING

.1 The final horizontal and vertical alignment shall be within the tolerances specified. To determine the acceptability of finished track immediately after construction, the parameters specified above will be measured with a rail-mounted track inspection device

capable of measuring with sufficient accuracy to establish that the track construction is within the tolerances specified herein. Track geometry deviations, as disclosed by the inspection specified above, shall be corrected and re-inspection shall be performed to ascertain those corrections have been made prior to Acceptance.

3.31 TRACK MATERIAL DISPOSAL

.1 Track materials to be removed shall become the property of the Contractor are to be removed from the site. All ties from removed track are to be disposed of offsite in an approved and environmentally responsible manner.

3.32 CLEANING

.1 Upon completion of the Work and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools, and equipment. The Contractor will restore the site to its original condition, all to the approval of the Contract Administrator.

Part 4 Protection of Existing Track and Structures

4.1 REQUIREMENTS

.1 The Contractor shall at all times conduct its operations in a responsible manner to avoid damage to adjacent trackage and structures. It shall be the Contractor's responsibility that all workers and persons employed by the Contractor or its agents, or under their control shall use due care that no person or property is injured, and that no rights are infringed in the execution of the Work.

.2 No Work that will impede railway traffic shall be undertaken without proper track protection.

.3 Care must be taken to ensure that no obstructions or hazards are created on City property that will interfere with the safe passage of trains or interfere with any plant process or chemical supply delivery. The Contractor shall not erect or allow to be erected any structure nor place any machinery or equipment closer than 3.3m to the gauge side of the nearest rail of a track on which traffic is maintained, without prior approval of the Contract Administrator.

.4 The Contractor is responsible for the proper care and storage of Work equipment at night, and at other times when equipment is not in use. All reasonable precaution must be taken to protect the equipment against unauthorized use, damage or tampering. Equipment stored on site must be clear of operating tracks.

.5 The Contractor shall erect markers, barricades or fences as required and post signs to warn all persons working on this project and the general public not to trespass on the Work site. Any road used to access to the Work site shall be properly maintained during use and repair if damaged.

.6 The Contractor shall take all necessary measures and care during the execution of the Work to protect and maintain in a stable condition, all temporary excavations, natural slopes, and structures.

.7 The Contractor must not excavate within the limits shown on the Contract Drawings for the existing tracks. All temporary excavations within the zone of potential train loading must be backfilled prior to train operations or be supported by temporary shoring designed by a registered Professional Engineer in the Province of Manitoba.

4.2 TRACK SETTLEMENT MONITORING

.1 Track settlement monitoring of adjacent City track infrastructure must take place during construction when there is potential impact to the condition of these tracks. It is expected that all existing tracks will be in as good or better condition at the end of any works as compared to prior to the start of Work.

.2 When the Contract Administrator deems necessary, the Contractor shall establish a baseline of any adjacent City tracks elevations by survey prior to the start of any works that shall or may affect the tracks in the project area. The baseline survey must include elevations of the top of rail on both rails of all tracks at intervals not to exceed 3m in areas mutually agreed upon by the Contractor and the Contract Administrator. The Contract Administrator reserves the right to require survey data at intervals less than 3m when deemed necessary to ensure the integrity of the track. Additional monitoring points should be located 10m beyond the limits of excavation activities adjacent to existing track. Proposed monitoring locations to be shown on a drawing to be verified by the Contract Administrator.

.3 The initial survey baseline results will be supplied to the Contract Administrator by the Contractor in a format that is easy to review. Minimum information required is a table including track id, rail id, station number and elevation however the Contract Administrator may request the information in alternate formats such as graphs depending on the specific project requirements.

.4 Once the installation of track monitoring points is complete, a monitoring program of all points is to be conducted in accordance with the following instructions:

.1 Monitoring should begin before the start of adjacent excavation activities and be done at least twice per day for no less than two days. This is required to establish a reliable methodology and demonstrate the accuracy achievable.

.2 Monitoring should proceed through the construction period and should be completed at least twice daily.

.3 Monitoring should continue for at least 3 days after the completion of construction.

.4 If there is any loss of ground during excavation activities, any reason to believe settlement may be delayed or any settlement is identified during the excavation activities or subsequent monitoring period, the monitoring must be continued until the Contractor’s geotechnical engineer deems it is safe to discontinue such monitoring.

.5 Monitoring measurements should be taken with sufficient frequency to capture the unexpected performance at the earliest possible stage and be evaluated in a timely manner. Additional measures will be proposed should this monitoring protocol is considered insufficient based on the ground conditions or installation process. Two alarm levels are proposed: -

Level 1:

"WARNING" will be indicated on the field memo when a settlement of 11mm from the surface settlement points. Work will be authorized to continue if no movement has been measured from the previous reading. If movement of the

rails is recorded, monitoring will be continued until movement is stopped at which time the excavation Work will then be authorized to continue.

Level 2:

"CRITICAL" will be indicated on the field memo when a settlement of 22mm is obtained from the surface settlement points. Work will be authorized to continue if no movement has been measured for at least two (2) readings taken 12 hours apart. If movement of the rails is recorded, monitoring will be continued until movement is stopped and a new excavation procedure has been submitted by the Contractor and approved by the Contract Administrator.

.6 The Contractor and their engineer are responsible for ensuring that track settlement does not occur and are to notify the Contract Administrator should unforeseeable track settlement occur or be expected. The above guidelines do not relieve the Contractor of this responsibility. The Contractor shall provide the settlement information and their interpretation of the data (no track settlement, deep settlement, etc. and how much track settlement has occurred, is likely to occur and when it is likely to occur). These concerns must be escalated to the following individuals: Contract Administrator, CP Geotechnical Engineering Department, and local Roadmaster.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 01 11 00 – Summary of Work

.2 40 00 50 – Process Piping

.3 40 03 15 – Process Pumps Skid Mounted

.4 40 05 01 – Chemical Storage Tanks

.5 40 09 10 – Identification

1.2 INTENT

.1 Provide complete, fully tested, and operational process systems to meet requirements described herein and in complete accord with applicable codes and ordinances.

.2 Contract Documents and Drawings of this Division are diagrammatic and approximately to scale unless stated otherwise. They establish scope, material, and installation quality, and are not detailed installation instructions.

.3 Follow Manufacturer's recommended installation instructions and procedures for equipment, supplemented by requirements of Contract Documents.

.4 Install equipment generally in locations and routes shown, 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.

.5 Install equipment to provide access and ease of maintenance.

.6 Connect to equipment specified in other Sections and to equipment supplied and installed by other contractors or by the City. Uncrate equipment, move in place and install complete; start up and test.

1.3 PERMITS, FEES, AND INSPECTIONS

.1 Apply for all permits, supply all test certificates and pay all fees to authorities having jurisdiction regarding the installation and inspection of the complete process systems, installed under this Contract.

1.4 EXISTING CONDITIONS AND OTHER TRADES

.1 Visit the Site to determine existing conditions affecting the Work of this Division. Failure to do so shall not remove the responsibility for the effects of such conditions on the Work.

.2 Examine the Mechanical, Structural, Electrical, and Controls and Instrumentation Drawings and become fully familiar with the Work of other trades under this Contract.

.3 Maintain the utmost cooperation with all other trades. Particular attention must be paid to the proximity of the Work to all electrical cables, control conduits, and utilities. Maintain

maximum clear ceiling heights throughout. Provide connections of sizes as shown on the Drawings for connection by other trades.

1.5 MATERIALS

.1 Materials and equipment installed shall be new, full weight and of quality specified. Use same brand or Manufacturer for each specific application.

1.6 SCOPE OF WORK

.1 Refer to Section 01 11 00 for the Scope of Work. The Work requires the supply and installation of such components as are necessary to construct complete functional and operational systems for all Sections of the Work.

.2 Consideration will not be granted for any alleged misunderstanding of the extent of the Work to be performed. Submitting a Bid shall convey full agreement to all items and conditions specified, indicated on the Drawings, and required by the nature of the Site.

1.7 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 or indicated in the other shall be considered as properly and sufficiently specified and shall therefore be provided.

.2 Should the Contractor find discrepancies or omissions in the Contract Documents, or be in doubt as to the intent thereof, he shall immediately obtain clarification from the Contract Administrator.

1.8 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.

1.9 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, Bylaws, 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 Contract Documents.

.6 Where the term “Submit for Review” is used herein, it shall be understood to mean submit 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.

1.10 SHOP DRAWINGS

.1 Refer to Section 01 33 00 for the requirements for Shop Drawings.

1.11 COORDINATION

.1 Coordinate locations of openings, housekeeping pads, and anchor bolts with other Divisions.

.2 Coordinate the connection of the services of other Divisions to the equipment and material supplied under this Division.

1.12 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 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 one metre; or if the change involves the addition of more than two fittings greater than 150 mm in diameter.

1.13 HOUSEKEEPING PADS

.1 Housekeeping pads are required for all pieces of equipment unless otherwise noted. Dimensions shown on the drawings are for guidance only. Housekeeping pads shall be at least 100 mm larger than the equipment base plates and 100 to 200 mm deep, unless

greater or lesser depths are required to support the equipment at the proper elevation. The final housekeeping pad dimensions shall be based on the dimensions of the actual equipment to be installed, and the Manufacturer's recommendations.

.2 The Contractor shall coordinate the location and installation of all the housekeeping pads, to be done by other Divisions.

1.14 METRIC CONVERSION

.1 All units in this division are expressed in SI units.

.2 Submit all Shop Drawings and maintenance manuals in SI units.

.3 On all submittals (Shop Drawings etc.) use the same SI units as stated in the Specifications.

.4 Where pipes are specified with metric dimensions and Imperial sized pipes are available, provide equivalent nominal Imperial sized pipe as indicated in the table, and provide at no extra cost adapters to ensure compatible connections to all metric sized fittings, equipment, and piping.

.5 When CSA-approved SI metric pipes are provided, the 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.

1.15 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.

.5 Use matching materials as specified in the respective Section.

1.16 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 crates and polyethylene covers.

.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.

1.17 TEMPORARY USAGE

.1 Usage by the City of any process device, apparatus, machinery or equipment prior to Total Performance being issued is not to be construed as acceptance.

1.18 PAINTING AND IDENTIFICATION

.1 Coordinate colour coding of piping and equipment with that of the existing plant. All piping and equipment are to be painted.

.2 Legend and direction of flow arrows shall consist of adhesive backed labels, yellow colour, with minimum 20 mm high black lettering equal to Brady System B-500, vinyl cloth labels for non-insulated surfaces; and Brady B 946 for insulated surfaces.

.3 Identify piping with labels, colour bands, and flow arrows. Provide identification at 15 m maximum intervals, before and after pipes pass through walls, at all sides of tees, behind access doors and in equipment rooms as required.

1.19 DELIVERY SCHEDULE

.1 The Contractor is to coordinate the equipment and material delivery schedule with the suppliers of the equipment and materials supplied under this Contract to suit the construction schedule.

1.20 DELIVERY

.1 The Contractor shall be responsible for unloading the equipment and materials supplied under this Contract and shall examine all packages on delivery, compare with the shipping list, and inform the supplier, the Contract Administrator and the carrier of any visible damages or defects. The Contractor shall arrange with the supplier to have the supplier replace any damaged or defective items.

1.21 STORAGE

.1 The Contractor shall provide temporary buildings and covered space for storage at the Site of all equipment prior to installation. The location of such buildings will be subject to acceptance by the Contract Administrator and the City.

.2 Pipe and any other materials shall be stored in a manner which prevents rust, deformation, weathering, or any other physical deterioration. Covered space shall be provided by the Contractor if necessary to provide for this protection.

.3 The Contractor shall adhere to the Manufacturers' storage recommendations.

.4 Heated covered storage space shall be provided by the Contractor for sensitive items of equipment such as motors and pumps, as well as other equipment or supplies specified in this Division or other Divisions.

1.22 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 a period of two (2) years would require that some specific spare parts are likely to be required, but are not listed in the Specification, the 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 Contractor shall so 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 Contractor of the responsibility to provide, at no cost, any spare parts required during the warranty period to repair malfunctioning or failed equipment. At the end of the maintenance period, the spare parts inventory shall be replenished to allow for the above.

Part 2 Products

NOT USED

Part 3 Execution

NOT USED

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 01 33 00 - Submittal Procedures

.2 01 78 00 - Closeout Submittals

1.2 REFERENCE STANDARDS

.1 Conform to the following reference standards:

.1 AWWA (American Water Works Association) B407: Liquid Ferric Chloride

.2 AWWA (American Water Works Association) B501: Sodium Hydroxide (Caustic Soda)

.3 NSF/ANSI 60: Drinking Water Treatment Chemicals Health Effects

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

.2 Submit material safety datasheet (SDS) for each chemical.

Part 2 Chemicals

2.1 CHEMICAL DESCRIPTION

.1 Ferric Chloride ($FeCl_3$) and Sodium Hydroxide (NaOH) are both extremely corrosive in certain environments. The properties of these chemicals are summarized in Table 2.2.1

.2 Refer to manufacturer’s chemical MSDS / SDS for chemical specific information.

.3 Chemical Properties:

Table 2.2.1: Chemical Properties

	Ferric Chloride ($FeCl_3$)	Sodium Hydroxide (NaOH)
Concentration	37 – 42%	50%
Appearance	Dark brown, slightly viscous liquid with faint acidic odor.	Colorless, odorless, slightly viscous liquid.
Freezing Temperature	-7°C (20°F)	12°C (54°F)
Specific Gravity	1.39 – 1.46	1.5

2.2 CHEMICAL USAGE

.1 Ferric Chloride ($FeCl_3$) and Sodium Hydroxide (NaOH) NEWPCC usage is estimated from existing data and is summarized in Table 2.2.2.

.1 Chemical usage rates should be taken as an approximation and may be subject to change based on requirements

Table 2.2.2: Chemical Usage

	Ferric Chloride ($FeCl_3$)	Sodium Hydroxide (NaOH)
Average Usage	15,626 L / day (4,128 USGAL / day)	3,170 L / day (837 USGAL / day)
Peak Usage	16,364 L / day (4,323 USGAL / day)	3,804 L / day (1,005 USGAL / day)

Part 3 Execution

3.1 EXAMINATION

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

3.2 MANUFACTURER'S REPRESENTATIVE

.1 Provide the services of a technically qualified Manufacturer's Representative for installation, testing and commissioning.

3.3 TESTING

.1 Ensure the equipment, including all component parts, operates as intended.

3.4 INITIAL FILL

.1 Contractor to perform initial fill of new ferric chloride and sodium hydroxide chemical tanks for commissioning.

.1 Contractor to assume and include purchase of required chemical in the bid.

.2 Contractor to verify the integrity and operation of chemical pumps and associated appurtenances during the initial fill.

3.5 COMMISSIONING

.1 Attend during commissioning of the process system which includes the equipment specified in this section and to ensure the equipment functions as intended in the process system.

3.6 CLEANING

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

.1 Leave Work area clean at end of each day.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 40 00 50 – General Process Provisions

.2 40 00 51 – Process Pipe Joints and Equipment Connections

.3 40 00 52 – Process Pipe Guides and Anchors

.4 40 00 53 – Process Pipe Expansion Joints

.5 40 00 55 – Detailed Process Piping Specification Sheets

.6 40 00 56 – Process Pipeline Appurtenances

.7 40 00 58 – Process Pipe Hangers and Supports

.8 40 01 00 – Process Valves

.9 40 40 00 – Process Piping Insulation

1.2 DESCRIPTION

.1 This section describes the pipe materials, fittings, appurtenances, installation and testing of the process mechanical systems.

.2 Use the general requirements specified in this section integrally with the more specific requirements listed in Section 40 00 55 Detailed Process Piping Specification Sheets.

.3 Piping supports are generally not shown on the process mechanical layout Drawings. Provide the design of piping supports, pipe guides, expansion joints and anchors based upon final piping layout. Typical support details and structural attachments shown on the Drawings indicate the level of quality that will be considered acceptable.

.4 The Contractor must provide the necessary submittals and ensure the proper registration of piping systems and system components as required by the Manitoba Steam and Pressure Vessels Act.

.5 Standard of Acceptance: Items specified by manufacturers name and/or catalogue number form part of this specification in order to define the standard regarding performance, quality of material and workmanship. When used in conjunction with a referenced standard, shall be deemed to supplement the standard.

1.3 DEFINITIONS

.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 1.0 m from the exterior face of a building or tunnel wall.

.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. Underground (or buried): placed in soil and not tied to structures.

.3 Below Structures: below concrete slabs such as tanks, channels, buildings, pipe chases, foundation slabs, etc., but not including roadways or walkway structures.

.4 Submerged: regularly or occasionally immersed in liquid; inside tanks or channels, and within 3.0 m above maximum water level of open tankage, including pipe and appurtenances within manholes, vaults, and chambers.

1.4 REFERENCE STANDARDS

.1 Conform to the most recent version of the following reference standards.

.1 ANSI/ASME A13.1, Scheme for the Identification of Piping Systems

.2 ANSI/ASME B1.20.1, Pipe Threads, General Purpose

.3 ANSI/ASME B16.1, Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800

.4 ANSI/ASME B16.3, Malleable Iron Threaded Fittings Class 150 and 300

.5 ANSI/ASME B16.5, Pipe Flanges and Flanged Fittings

.6 ANSI/ASME B16.9, Factory-Made Wrought Steel Butt Welding Fittings

.7 ANSI/ASME B16.11, Forged Steel Fittings, Socket Welding and Threaded.

.8 ANSI/ASME B16.12, Cast Iron Threaded Drainage Fittings

.9 ANSI/ASME B16.15, Cast Bronze Threaded Fittings, Classes 125 and 250

.10 ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings

.11 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

.12 ANSI/ASME B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes

.13 ANSI/ASME B31.1, Power Piping

.14 ANSI/ASME B31.3, Process Piping

.15 ANSI/ASME B31.9, Building Services Piping

.16 ANSI/ASME B36.10M, Welded and Seamless Wrought Steel Pipe

.17 ANSI/ASME B36.19M, Stainless Steel Pipe

.18 ASME Section IX, Boiler and Pressure Vessel Code, Welding and Brazing Requirements

.19 ASTM A47, Malleable Iron Castings

.20 ASTM A53, Pipe, Steel, Black and Hot Dipped, Zinc Coated Welded and Seamless

.21 ASTM A74, Cast Iron Soil Pipe and Fittings

.22 ASTM A105/A105M, Forgings, Carbon Steel, for Piping Components

.23 ASTM A106, Seamless Carbon Steel Pipe for High Temperature Service

.24 ASTM A126, Grey-Iron Castings for Valves, Flanges, and Pipe Fittings

.25 ASTM A135, Electric-Resistance-Welded Steel Pipe

.26 ASTM A139, Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and Over)

.27 ASTM A167, Stainless Steel and Heat-Resisting Chromium-Nickel Steel Plate

.28 ASTM A181/181M, Forgings, Carbon Steel, for General Purpose Piping

.29 ASTM A182/182M, Forged or Alloy Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service

.30 ASTM A193/193M, Alloy Steel and Stainless-Steel Bolting Materials for High Temperature Service

.31 ASTM A194/194M, Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service

.32 ASTM A197, Cupola Malleable Iron

.33 ASTM A234/A234M, Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

.34 ASTM A240, Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels

.35 ASTM A269, Seamless and Welded Austenitic Stainless-Steel Tubing for General Service.

.36 ASTM A276, Stainless and Heat-Resisting Steel Bars and Shapes

.37 ASTM A285/A285M, Standard Specification for Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength

.38 ASTM A307, Carbon Steel Bolts and Studs, 60 000 psi Tensile Strength

.39 ASTM A312/312M, Seamless and Welded Austenitic Stainless-Steel Pipe

.40 ASTM A320/320M, Alloy Steel Bolting Materials for Low-Temperature Service

.41 ASTM A351/A351M, Standard Specification for Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts

.42 ASTM A380, Standard Practice for Cleaning, Descaling and Passivation of Stainless-Steel Parts, Equipment and Systems

.43 ASTM A403/A403M, Wrought Austenitic Stainless Steel Piping Fittings

.44 ASTM A409/A409M, Welded Large Diameter Austenitic Steel Pipe for Corrosive or High Temperature Service

.45 ASTM A480/A480M, General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

.46 ASTM A536, Ductile Iron Castings

.47 ASTM A563, Carbon and Alloy Steel Nuts

.48 ASTM A570/A570M, Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality

.49 ASTM A774/A774M, As-Welded Wrought Austenitic Stainless-Steel Fittings for General Corrosive Service at Low and Moderate Temperatures

.50 ASTM A778, Welded, Unannealed Austenitic Stainless Steel Tubular Products

.51 ASTM A967, Standard Specification for Chemical Passivation Treatment for Stainless Steel Parts

.52 ASTM B32, Standard Specification for Solder Metal

.53 ASTM B88, Seamless Copper Water Tube

.54 ASTM C76, Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

.55 ASTM C564, Rubber Gaskets for Cast Iron Soil Pipe and Fittings

.56 ASTM D638, Test Method for Tensile Properties of Plastics

.57 ASTM D792, Test Method for Specific Gravity and Density of Plastics by Displacement

.58 ASTM D1248, Polyethylene Plastics Moulding and Extrusion Materials

.59 ASTM D1457, PTFE Moulding and Extrusion Materials

.60 ASTM D1599, Standard Test Method for Short-Time Hydraulic Failure Pressure or Plastic Pipe, Tubing and Fittings

.61 ASTM D1784, Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds

.62 ASTM D1785, Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

.63 ASTM D2105, Standard Test Method for Longitudinal Tensile Properties of “Fiberglass” (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Tube

.64 ASTM D2241, Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)

.65 ASTM D2412, Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading

.66 ASTM D2466, Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40

.67 ASTM D2467, Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

.68 ASTM D2513, Thermoplastic Gas Pressure Pipe, Tubing, and Fittings

.69 ASTM D2529, Standard Practice for Measuring Beam Deflection for Reinforced Thermosetting Plastic Pipe Under Full Bore Flow

.70 ASTM D2657, Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings

.71 ASTM D2564, Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings

.72 ASTM D2665, Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings

.73 ASTM D2996, Filament-Wound Reinforced Thermosetting Resin Pipe

.74 ASTM D3212, Joints for Drain and Sewer Plastic Pipes using Flexible Elastomeric Seals

.75 ASTM D3261, Butt Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Fittings

.76 ASTM D3350, Standard Specification for Polyethylene Plastics Pipe and Fitting Materials

.77 ASTM D4024, Standard Specification for Reinforced Thermosetting Resin (RTR) Flanges

.78 ASTM D4101, Propylene Plastic Injection and Extrusion Materials

.79 ASTM D4174, Cleaning, Flushing, and Purification of Petroleum Fluid Hydraulic Systems

.80 ASTM F441, Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80

.81 ASTM F714, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR).

.82 Based on outside Diameter.

.83 ASTM F894, Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe

.84 AWWA C105, Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids

.85 AWWA C110, Ductile-Iron and Grey-Iron Fittings, 3 Inch through 48 Inch, for Water and Other Liquids

.86 AWWA C111, Rubber-Gasket Joints for Ductile-Iron and Grey-Iron Pipe and Fittings

.87 AWWA C115, Flanged Ductile-Iron and Grey-Iron Pipe with Threaded Flanges

.88 AWWA C151 (ANSI A21.51), Ductile-Iron Pipe, Centrifugally Cast in Metal Moulds or Sand-Lined Moulds, for Water and Other Liquids

.89 AWWA C200, Steel Water Pipe, 6 Inches and Larger

.90 AWWA C203, Coal Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied

.91 AWWA C205, Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 Inches through 144 Inches

.92 AWWA C206, Field Welding of Steel Water Pipe

.93 AWWA C207, Steel Pipe Flanges for Waterworks Services - Sizes 4 Inch Through 144 Inch

.94 AWWA C208, Dimensions for Fabricated Steel Water Pipe Fittings

.95 AWWA C209, Cold-Applied Tape Coating for Special Sections, Connections, and Fittings for Steel Water Pipelines

.96 AWWA C210, Liquid Epoxy Coating System for the Interior and Exterior of Steel Water Pipe

.97 AWWA C214, Tape Coating Systems for the Exterior of Steel Water Pipelines

.98 AWWA C301, Prestressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids

.99 AWWA C303, Reinforced Concrete Pressure Pipe - Steel Cylinder Type, Pretensioned, for Water and Other Liquids

.100 AWWA C600, Installation of Ductile-Iron Water Mains and their Appurtenances

.101 AWWA C606, Grooved and Shouldered Joints

.102 AWWA C651, Disinfecting Water Mains

.103 AWWA C900, Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inches through 12 Inches, for Water

.104 AWWA C906, Standard for Polyethylene (PE) Pressure Pipe and Fittings 4 in.

.105 Through 63 in., for Water Distribution

.106 AWWA M11, Steel Pipe - A Guide for Design and Installation

.107 CGA, Canadian Gas Association Standards

.108 CAN/CGA B105 - Installation Code for Digester Gas Systems

.109 CAN/CSA B70, Cast Iron Soil Pipe, Fittings and Means of Joining

.110 CISPI 301, Specification Data for Hubless Cast Iron Sanitary System with No-Hub Pipe and Fittings

.111 CAN/CSA B139, Installation Code for Oil Burning Equipment

.112 CAN/CSA B149.1, Natural Gas and Propane Installation Code

.113 MPC, Manitoba Plumbing Code

.114 CSA B52, Mechanical Refrigeration Code

.115 CSA B137.1, Polyethylene Pipe, Tubing and Fittings for Cold Water Pressure Services

.116 CSA B137.3, Rigid PVC Pipe for Pressure Applications

.117 CAN/CSA B181.2, PVC Drain, Waste, and Vent Pipe and Pipe Fittings

.118 CAN/CSA B182.2, PVC Sewer Pipe and Fittings (PSM Type)

.119 CSA CAN-Z183, Oil Pipeline Systems

.120 CSA CAN3-Z299.3, Quality Verification Program Requirements

.121 EJMA STDS-93, Standards of Expansion Joint Manufacturers' Association, Edition No. 6

.122 Fluid Sealing Association Technical Handbook, Rubber Expansion Joint Division

.123 FEDSPEC, L-C-530B(1), Coating, Pipe, Thermoplastic Resin or Thermosetting Epoxy

.124 MIL-H-13528B, Hydrochloric Acid, Inhibited, Rust Removing

.125 MIL-S-8660C, Silicone Compound

.126 MIL-STD-810C, Environmental Test Methods

.127 MSS SP25, Standard Marking System for Valves, Fittings, Flanges and Unions

.128 MSS SP43, Wrought Stainless-Steel Butt-Welding Fittings

.129 NACE RP0178, Fabrication Details, Surface Finish Requirements, and Proper Design Considerations for Tanks and Vessels to be Lined for Immersion Service.

.130 SAE J1227, Assessing Cleanliness of Hydraulic Fluid Power Components and Systems

.131 SSPC-P3, Canadian Government Standards Board

.132 SSPC-SP6, Canadian Government Standards Board

.133 SSPC-SP10, Canadian Government Standards Board

.134 NPC, National Plumbing Code

.135 Plastics Pipe Institute's PPI Handbook of Polyethylene Piping, chapter " Underground Installation of PE Piping " and chapter "Specifications, Test Methods and Codes for Polyethylene"

.136 TSSA, Technical Standards and Safety Association

.137 Provincial Building Code

.138 Provincial Plumbing Code

1.5 DESIGN REQUIREMENTS

.1 The design has been completed to the degree necessary for the Contractor to Bid. It is not fully detailed and will require the Contractor to undertake design of and responsibility for minor aspects for the piping systems to be installed.

.2 All process piping shall meet requirements of the Process Piping Code, B31.3, whether or not it falls within the Code scope. The Manitoba Steam and Pressure Plants Act shall be the Code Authority whenever the piping system falls within the Code scope. The Contract Administrator shall be the Code Authority for process piping that does not fall within the Code scope.

.3 Piping and instrumentation Drawings, piping schematics, and piping layout Drawings are contained in the Drawings set. The piping and instrumentation Drawings (P&IDs) indicate all major pipework, valves, and appurtenances (other than cleanouts, purge points, etc.) The layout Drawings indicate the design concepts and are intended to illustrate a constructible method for the piping systems. Some appurtenances, supports, guides and anchors, and expansion joints are not fully shown. The Contractor's design will complement and detail these Drawings.

.4 It is understood that some conflicts will arise that will require that the Contractor re-route some of his piping to allow for the installation of wiring, ventilation duct, or similar.

.5 The Contractor is required to engage a Professional Engineer registered in the Province of Manitoba to be responsible for the final aspects of the design. The components of the design that will be generated will be as follows:

.1 Final layout, illustrated using layout and isometric drawings.

.2 Piping flexibility and stress analysis proving that the allowable stresses prescribed by the Process Piping Code B31.3 are not exceeded under any prescribed combination of conditions, and indicating the forces and moments in each direction under each condition at each support, guide or anchor.

.3 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.

.4 Expansion and contraction design, including the layout and details for all necessary expansion joints needed to compensate for thermal expansion and contraction, structural movement, and the isolation of equipment.

.5 Thrust restraint design, including thrust restraint required due to any forces imposed during construction, pressure testing, normal operation, and/or surging, if applicable. The thrust restraint design shall include a minimum safety factor of 2.0 using the maximum thrust force that will be experienced during construction, pressure testing, normal operation, and/or surging, if applicable. This requirement applies to new piping systems as well as to existing piping systems that may be modified.

.6 The piping system shall have sufficient flexibility to prevent thermal expansion or contraction, or movements of piping supports and terminals causing:

.1 Failure of piping or supports from overstress or fatigue

.2 Leakage at joints

.3 Detrimental stresses or distortion in piping and valves or in connected equipment or piping systems not designed by the Contractor, resulting from excessive thrusts and moments in the piping.

.6 Design documentation will be submitted to the Contract Administrator as necessary to indicate compliance with the requirements of the piping systems. The documentation will be signed and sealed by a Professional Engineer registered in the Province of Manitoba, who must provide evidence of experience with such systems.

.7 Note that for large diameter, thin walled (thickness less than 1 percent of diameter) piping comprehensive flexibility and stress analysis is required, even if the design met the exception granted under section 319.4.1(c) of the Process Piping Code B31.3.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 For each piping system refer to Section 40 00 55, submit documentation listing pipe, fittings, flexible connectors, expansion joints, linings, coatings, and valving to be used for each pipe size and category.

.3 Radiographic Weld Testing

.1 Submit the name and qualifications of at least two independent firms for the radiographic weld testing to be undertaken by the Contractor if and as required by the applicable Code. The selected firm will be subject to the review and acceptance of the Contract Administrator.

.4 A copy of this specification section and all referenced sections with each paragraph check- marked to show compliance or highlighted to indicate deviation.

.5 For all pipe greater than or equal to 50 mm diameter, submit isometric drawings, to indicate the assembly details, the welds, flanges, valve placement, cathodic protection, expansion joints, guides, anchors, hangers, supports, and the provisions for thrust restraint, as well as any other pertinent details.

.6 Submit piping layout drawings by plant area which indicate location and placement of valves, fittings and other appurtenances for all piping, greater or equal to 150 mm diameter, in that area. Indicate location and clearances from structures and other utilities (ductwork, conduit, electrical tray, etc.)

.7 Submit copies of all original submittals and all related correspondence made as part of the regulatory submission required by the Manitoba Steam and Pressure Plants Act and any submissions required by other regulatory authorities.

.8 Product Samples

.1 Where specified or when directed by the Contract Administrator, provide mill test results or product samples.

.9 Provide hanger, guide, anchor, support system design details including locations, load information, design calculations and illustrative drawings, signed and sealed by a Professional Engineer registered in the Province of Manitoba. Refer to Section 11052.

.10 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, signed and sealed by a Professional Engineer registered in the Province of Manitoba. Refer to Section 11053.

.11 Welding

.1 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 signed and sealed by a Professional Engineer registered in the Province of Manitoba and qualified for welding design. For stainless steel welds exposed to process fluids, the weld procedure should provide for maximizing the corrosion resistance of the final weld as well as providing the mechanical strength required.

.12 Radiographic weld test results

.13 Prior to the commencement of welding, submit current and complete documentation of the welder's qualifications.

.14 Product Data:

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

1.7 CLOSEOUT SUBMITTALS

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

1.8 MAINTENANCE MATERIAL SUBMITTALS

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

1.9 COORDINATION

.1 Process and Utility Piping identification

.1 Refer to Section 40 09 10 for process 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). The commodity codes are defined in the Drawings.

.3 Detailed process pipe Specifications are provided for each commodity in Section 40 00 55.

.4 Routing

.1 Coordinate piping installation routes and elevations with installation of sheet metal, process equipment, HVAC, instrumentation, and electrical work.

.5 Pipe sleeves

.1 Coordinate with other divisions to locate and place sleeves in cast-in-place concrete and in masonry building elements prior to construction.

.6 Coordinate with Divisions 25 and 26 to provide correct piping configuration for primary instrumentation elements. For example, provide required minimum straight run of pipe upstream and downstream of flow meters. Coordinate with Division 25 and 26 for meter manufacturer’s requirements.

1.10 QUALITY ASSURANCE

.1 Welding certification

.1 All welders to be certified under the Manitoba Steam and Pressure Plants Act. As a minimum, welders will hold a Level B Journeyman Welder’s Certificate.

.2 All welders who work on this project must provide the correct documentation.

.3 Welders working on stainless steel piping must not work on welding of any other material.

.4 Tools used for stainless steel piping welding must be new and marked for this use. These tools must not be used for any other work. Tools must not be made of materials that could contaminate the stainless-steel surface.

.2 Weld tests

.1 All piping welds shall be 100 precent 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 full circumference radiographic inspection for every 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 Contractor to provide for one full circumference radiographic inspection for every 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.

.4 Have radiographic test firm evaluate welds in accordance with ANSI/ASME B31.3 Process Piping Code Normal Service and prepare report summarizing results.

.5 Have radiographic weld test report, complete with results, submitted directly to Contract Administrator.

.6 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 regulatory submissions as required by the Manitoba Steam and Pressure Plants Act.

.2 Complete all other submissions as required by other regulatory authorities.

1.11 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.

1.12 DELIVERY, STORAGE AND HANDLING

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

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

.3 Storage and Handling Requirements:

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

.2 Replace defective or damaged materials with new.

.4 Deliver pipe, fittings, and specials to site using loading methods which do not damage pipe or coatings.

.5 Piping materials delivered to site will be clearly marked to indicate size, type, class/schedule and coatings.

.6 Until ready for incorporation in the work, store on site as recommended by the piping materials manufacturer to prevent damage, undue stresses, or weathering.

.7 Store materials at least 200 mm above ground with sufficient supports to prevent undue bending.

.8 Protect non-UV light inhibited plastic from sunlight.

.9 Ship pipe expansion joints, anchors, guides and flexible connectors pre-assembled to the degree which is practical.

.10 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.

1.13 WARRANTY

.1 Contractor shall supply new materials and re-do the Work should materials be found to be defective or not in compliance with the Specifications, or should the workmanship be found to be inadequate or the Work was not performed in accordance with the Specifications and referenced standards, codes and regulations. This warranty shall remain in effect for the maximum period of time allowed under Law.

.2 Neither the Contract Administrator's inspections, checks, or any other tests or subsequent authorization to proceed with the Work, nor the Contract Administrator's waiving of the Contract Administrator's right to perform such tests, nor the Contract Administrator's decision not to solicit submission of material certificates or other quality assurance documentation relieve the Contractor from any degree of responsibility in regard to the Work or the corresponding warranty above. The Contractor agrees that the Contract Administrator's ability to fully assess the suitability of materials, procedures, worker qualifications and other relevant issues is limited. The Contractor bears full responsibility and is solely liable in these matters.

.3 The use of faulty materials or materials that do not meet the Specifications and referenced standards, codes and regulations shall constitute a hidden defect.

.4 Employment of labour not properly qualified the performance of the work not in accordance with the Specifications and the referenced standards, codes and regulations, and the use of inadequate of sub-standard workmanship shall constitute hidden defects.

Part 2 Products

2.1 FUNCTION

.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 in Section 40 00 55.

.2 Where any standard referenced has been superseded prior to bidding, the Contractor shall comply with the new standard.

2.3 PIPE SIZES

.1 Where the pipe size is not specified, provide pipe with the sizes required by the Manitoba and National Plumbing Codes. For small piping not described by the Manitoba and National Plumbing Codes, use 12 mm nominal diameter.

2.4 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 otherwise shown. Provide smooth flow carbon or stainless-steel elbows 350 mm and less, to ANSI B16.9. Provide mitred elbows greater than 350 mm, to AWWA C208 unless otherwise shown or specified. Use 3-piece construction unless otherwise shown or specified.

.4 Provide fittings in concrete cylinder pipe fabricated from metal plate, cement lined and coated, and in accordance with AWWA C301. Dimensions to AWWA C208.

.2 Stainless steel pipelines

.1 Less than 75 mm diameter: provide fittings of the same class as the pipe, conforming to ASTM A403 and ANSI B16.11.

.2 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 pipelines

.1 Provide PVC to CSA B137.3, of the same material and class as the pipe.

.4 Copper pipelines

.1 Provide copper fittings in conforming to ANSI B16.26.

.5 Polyethylene pipelines:

.1 Provide fittings in the same material and class as the pipe.

.2 Thermal butt fusion joints to ASTM D2774.

.6 Buried pipelines

.1 For buried piping and piping inside carrier pipes, refer to Drawings.

2.5 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. Refer to the detailed pipe Specification sheets for the recommended gasket material. Material designations used in the detailed pipe specification sheets are as follows:

.1 EPDM: ethylene-propylene-diene-terpolymer 70 durometer

.2 Bl. Neoprene: neoprene (black) 70 durometer (not acceptable in stainless steel pipe systems)

.3 Nitrile: nitrile (Buna N)

.4 SBR: Styrene-butadiene (red)

.5 Natural rubber: natural rubber

.6 Compressed synthetic fibres (Kevlar): ASTM F104 (F712400), and neoprene binder:

.7 1.7 MPa (ASTM F152), 0.2 mL/h Leakage Fuel A (ASTM F37)

.8 Compressed synthetic fibres (Kevlar): ASTM F104 (F712400) and SBR binder:

.9 1.7 MPa (ASTM F152). 0.1 mL/h Leakage Fuel A (ASTM F37)

.10 Gylon Type 1: Garlock Style 3500. 1.35 MPa (ASTM F152). 0.22 mL/h Leakage Fuel A (ASTM F37)

.11 Gylon Type 2: Garlock Style 3510. 1.35 MPa (ASTM F152). 0.04 mL/h Leakage Fuel A (ASTM F37)

.12 CPE: chlorinated polyethylene

.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; for epoxy lined piping systems for solids carrying liquids, provide end-seal type gaskets.

.3 Unless otherwise specified, provide flush seal type gaskets for all other grooved joint systems. Acceptable products: Gustin-Bacon Rigigrip, Victaulic Flush-Seal.

2.6 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, Grade A.

.3 Provide stainless steel bolts, nuts and washers for exposed, submerged, buried and concrete encased service; bolts conforming to ASTM A193, Grade B8, C1.1; nuts conforming to ASTM A194, Grade 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.

2.7 CATHODIC PROTECTION

.1 Provide cathodic protection of piping, pipe fittings and appurtenances.

2.8 STRUCTURAL ELEMENT PENETRATIONS

.1 Structural element penetrations are shown and referenced to a detail or Process/Mechanical Standard Detail. 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 HDPE 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. Continuously weld the water stop flange, both sides, onto the pipe or pipe sleeve. Fill annular space between the sleeve and pipe, where a sleeve is used, with non shrink grout in accordance with Division 3. Form reglets between the grout and the concrete and between the grout and the pipe, on "wet" sides of the wall penetration. Fill reglet with sealant.

.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 outside diameter of the pipe. For pipes 75 mm and less furnish a pipe sleeve 25 mm larger than the outside diameter of the pipe.

.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 outside diameter. For pipes 75 mm and less furnish a pipe sleeve 25 mm larger than the outside diameter of the 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 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.

Part 3 Execution

3.1 EXAMINATION

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

.1 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 Piping arrangements indicated on the Drawings have been established on the basis of the "Design Standard" listed in the specific process equipment sections. If the equipment to be provided is not the Design Standard, modify the piping arrangement as necessary at no additional expense to the City.

.4 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.

.5 Include any piping modifications in the Shop Drawings submitted prior to fabrication or installation.

3.2 PIPING 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 Damaged glass lining cannot be repaired. Damaged pipe must be replaced.

.5 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.

.6 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 ensure that the piping deflection between lifting points does not exceed 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 drawings or Section 40 00 51.

.2 Pipe laying and bedding: conform to drawings or Section 40 00 51.

.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 Provide Yellow Jacket or tape wrap on all fittings and flanged, grooved, plain end and welded joints underground and below structures.

.7 Unless otherwise specified or shown, for underground piping provide groove joints or flex coupled joints at 6000 mm on centre.

.8 Use anti-seize compound with all stainless-steel nuts and bolts.

.9 Prior to installation provide a Manufacturer's Representative, from the HDPE pipe manufacturer, for a minimum of one day to instruct personnel on installation procedures of HDPE pipe.

3.5 INSTALLATION

.1 Fabricate and install process and pressure piping in accordance with the Process Piping Code B31.3 and the Manitoba Steam and Pressure Plants Act. Fabricate and install domestic hot and cold-water piping, sanitary piping and storm drainage piping in accordance with the Manitoba and National Plumbing Codes.

.2 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 Contractor is responsible for the design, supply, and installation of the piping system in general accordance with the indicated requirements.

.3 Install pipe support system to adequately secure the pipe and to prevent undue vibration, sag or stress.

.4 Install expansion joints where shown and at other locations as necessary to allow for piping expansion and contraction.

.5 Provide temporary supports as necessary during construction to prevent overstressing of equipment, valves, or pipe.

.6 Accurately cut all piping for fabrication to field measurements. Process air piping sections shall be measured and cut at a temperature between 15ºC and 20ºC. 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 15ºC to 20ºC and such that they will not deflect excessively during handling and installation. These blocks shall be removed prior to pressure testing.

.7 Install pipes in straight alignment. For large diameter (500 mm nominal diameter and greater), thin-walled (6.4 mm and less) stainless steel piping provide laser alignment of

all pipe supports. Lateral and vertical misalignment between any three consecutive supports shall not exceed the pipe wall thickness.

.8 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.

.9 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.

.10 Slope instrument air piping to condensate traps. Provide condensate traps as recommended by the manufacturer of the instrument air compressor.

.11 Do not cut or weaken the building structure to facilitate installation.

.12 In parallel pipe runs, offset flanges and 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 crossing over cable trays. The drip trays will be 300 mm wider and 600 mm longer than the piping area over the cable tray.

3.6 STAINLESS STEEL WELDING

.1 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.

.2 For all stainless-steel pipe intended to convey liquids, use inert gas backing for field and shop welds (GMAW or GTAW). For these services, "Solar Flux" and similar products will not be allowed.

.3 Ensure the first bead obtains full root penetration with a minimum of weld material projecting within the pipe.

.4 Grind or buff all welds to a minimum radius of 6 mm 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 6 mm radius, make radius one half of material thickness.

.5 Ensure the outside diameter weld (weld cap) is free of excessive weld cap and free of discoloration due to welding. Ensure all inside diameter welds (root pass) or outside diameter welds exposed to wastewater or corrosive fluids/environments are ground flush and have no discoloration.

.6 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 due to overheating.

.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 percent nitric acid and 2 percent hydrofluoric acid in chloride-free water. Treat for no less than 2 hours at 20ºC to 40ºC. Do not do the work at less than 20ºC. 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

.6 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 20ºC at the outlet end) overnight.

.7 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 City at the closest primary effluent channel. Note that the City may limit the volume that may be discharged over any period of time. Take measures to prevent freezing.

.8 Process air piping may not be filled with water unless laid flat on the ground or otherwise supported every 5000 mm and on each side of sliding supports.

.9 Pickling and passivating may require the ingress of an individual into the process air pipe. A single individual may do so once the pipe has been installed. 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. Confined entry procedures shall apply. Footwear, other items or tools that could scratch the stainless-steel surface shall not be carried into the pipe.

3.7 PAINTING REPAIRS AND RESTORATION

.1 Do painting in accordance with Section 09 91 23 - Interior Painting.

.2 Prime and touch up marred finished paintwork to match original.

.3 Restore to new condition, finishes which have been damaged.

3.8 TESTING

.1 Give the Contract Administrator 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 percent copper sulphate solution. After ten minutes at not less than 15ºC 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 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/h per mm pipe diameter per 100 m of pipe length for buried piping, unless otherwise specified.

.6 Test drains in accordance with the Manitoba and National Plumbing Codes.

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, or vapour in accordance with Process Piping Code B31.3 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 media:

Pipe Size	Testing Pressure	Test Medium
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 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 percent of the specified test pressure as the allowable leakage rate 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 that 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.

.8 Test natural gas piping in accordance with CAN/CGA B139-1.

3.11 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
25 and smaller	1.5
30-75	6.25
80-150	12.5
150 and greater	25

.3 Maintain the screens during testing, flushing/purging, initial startup, 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 15 minutes and until no debris is collected in the screens.

.5 Remove the screens and make the final connections after the screens have remained clean for a minimum of 24 consecutive hours of operation. Screens in solids handling systems are exempt; remove prior to placing the system in service.

.6 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.

.7 Brush clean steel pipe exterior to SSPC-P3 standard prior to painting.

3.12 DISINFECTION

.1 Disinfect lines intended for potable water service after testing in accordance with AWWA C651.

3.13 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.

3.14 PROTECTION

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

END OF SECTION

Part 1 GENERAL

1.1 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 00 50. Use the general requirements specified in this section and Section 40 00 50 integrally with the more specific requirements listed in Section 40 00 55.

1.2 SUBMITTALS

.1 With the submittals required in Section 40 00 50, provide a listing of joining and connecting techniques used in the performance of the work.

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 00 50 for welding quality assurance requirements.

1.5 SHIPMENT, PROTECTION AND STORAGE

.1 Refer to Section 40 00 55.

Part 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.

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 and/or isolating flanges.

2.5 CARBON STEEL PIPING

.1 Less than 75 mm in diameter: butt-weld or use threaded couplings. Use unions where disassembly is required.

.2 Equal to or greater than 75 mm in diameter: where not specified or shown otherwise, butt-weld according to ASME Boiler and Pressure Vessel Code or furnish flanges, conforming to ANSI B16.5, Class 150. Where disassembly is required, flanges are sufficient.

.3 Companion flanges for connection to cast iron or ductile iron equipment flanges shall be refaced to be flush with the companion flange.

.4 Where grooved joint fittings are shown for use in steel piping systems, meet the following requirements:

.1 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 77.

.2 Use rigid style couplings in all other applications. Acceptable products are Gustin-Bacon 120 Rigi-Grip and Victaulic Style 07 Zero-Flex.

.3 With the Contract Administrator’s prior acceptance, flange assemblies may be substituted for above ground 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 COPPER OR BRASS PIPING

.1 Use soldered couplings. Where disassembly is required, use compression unions.

.2 Use soldered couplings conforming to ANSI B16.26. Use lead free solder conforming to ASTM B32 and the National Plumbing Code.

.3 In potable water systems, use lead free solder conforming to ASTM B32 and National Plumbing Code.

.4 Solder used in DWV systems will be 50/50 type.

.5 Furnish compression couplings for copper and brass tubing of copper, suitable for the maximum pressure of the pipe, conforming to ANSI B16.26.

2.7 PVC AND FRP PIPING

.1 Where not shown or otherwise specified, use solvent weld joints for PVC and FRP piping.

.2 Provide flanges or unions where disassembly is required.

2.8 HDPE PIPING

.1 Refer to pipe manufacturer's specifications for product information and installation instruction.

.2 HDPE pipe joined by method of thermal butt fusion should conform to ASTM D 2657.

.3 Provide bell and spigot type joints conforming to ASTM D3212.

.4 Provide pipe, pipe support, and restraints to withstand stresses induced by joint design.

.5 .5 Provide pipe, pipe supports, and restraints to withstand the stresses incurred during

.6 placement of concrete surround.

2.9 FLANGES

.1 General requirements for flanges are as follows:

.2 Provide compatible flanges for mating to equipment or valves.

.3 Provide flat-faced flanges on each side of butterfly valves.

.4 For steel piping, provide weld neck flanges on both sides of wafer or lug body valves.

.5 A lap joint flange on digester gas services or Van Stone flange on schedule 10S stainless steel piping systems is acceptable.

.6 Do not use slip-on flanges that are attached to a pipe by means of set screws and gaskets (uni-flange, etc.)

2.10 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.

2.11 FLEXIBLE COUPLINGS - TYPE I

.1 Unless specifically shown otherwise, use Type I flexible couplings where a flexible coupling is shown or required.

.2 Type I General Requirements:

.1 Center ring: steel, shop coated for corrosion protection.

.2 Gaskets: fabricated of material suitable to the service conditions.

.3 For submerged, buried or below structure applications, use stainless steel bolts, nuts and washers and provide center ring with epoxy coating.

.4 Provide the necessary amount and appropriate size of restraining rods and gussets as recommended by the manufacturer.

.5 Type 1 Restrained: use a flexible sleeve-type coupling with restraining rods, and gussets welded to the pipe. Provide sufficient restraint to resist pressure equal to twice the system test pressure.

.6 Do not use Type 1 flexible couplings in pipe systems which undergo thermal expansion and contraction; also, do not use these couplings at structural joints.

.3 Flexible Couplings Type IA

.1 Flexible sleeve type couplings: cylindrical centre ring, two follower rings, two resilient gaskets, and connecting bolts.

.2 Acceptable products are:

.1 Dresser Style

.2 Ford Meter Box

.3 Robar

.4 .4 Rockwell

.5 .5 Viking Johnson

.4 .4 Flexible Couplings Type IB

.1 Flanged flexible sleeve type couplings: flanged cylindrical centre ring, a companion flange, one follower ring, one resilient gasket, and connecting bolts.

.2 Acceptable products are:

.1 Dresser

.2 Ford Meter Box

.3 Robar

.4 Rockwell

.5 Viking Johnson

.2 .5 Flexible Couplings Type IC

.1 Transition flexible sleeve type couplings: Cylindrical centre ring, two follower rings two resilient gaskets, and connecting bolts.

.2 Acceptable products are:

.1 Dresser

.2 Robar

2.12 FLEXIBLE COUPLINGS TYPE II

.1 Flexible pipe couplings: progressive sealing, capable of two degrees angular deflection in all directions, leakproof.

.2 Acceptable manufacturers:

.1 .1 Straub

.2 .2 Young Nam Company (YNC)

.3 Casing: 304 or 316 stainless steel.

.4 Lockparts: Steel, shop coated for corrosion protection. 304 stainless steel for buried or submerged services.

.5 Gaskets: fabricated of material suitable to the service conditions.

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.

Part 3 EXECUTION

3.1 WELDING

.1 Refer to Section 40 00 50 for welding requirements.

3.2 THREADED JOINTS

.1 Conform to the requirement of ANSI B31.3 Process Piping Code.

.2 Ream the end of all pipes to remove all burrs and cuttings when fabricating threaded joints.

.3 Clean out pipe and repair linings and coatings prior to joining.

.4 Apply Teflon tape to male threads and join pipe. Use both Teflon tape and Teflon sealing compound on stainless steel pipe threads. Do not use extra tape to make up for slack in the joint.

.5 Provide joints at spacings noted in Section 11055 to allow for pipe disassembly.

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 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.

.8 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.

END OF SECTION

PROCESS PIPE JOINTS AND EQUIPMENT CONNECTIONS

Table - Pipe Connections for Various Equipment End Types

Piping Material	Pipe Type	Diameter Range	Equipment End								
			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	Fiberglass Flanged	PVC Female Thread
Steel	SCH40	10 to 65		150 mm Galvanized Threaded Nipple and Union Rating: 250	150 mm Galvanized Threaded Nipple and Union Rating: 250	Threaded Steel Flange Rating: 125 FF	Threaded Steel Flange Rating: 150 RF	Flexible Joint Flanged One End Rating: Class 150 RF or Flange Adaptor and Van Stone Flange Rating Class 150 RF			150 mm Galvanized Threaded Nipple and Union Rating: 250
		Greater than 65				Steel Flange Rating: 125 FF	Threaded Steel Flange Rating: 150 RF	Flexible Joint Flanged One End Rating: Class 150	Butt Welded (Steel Equipment End)		
Copper		10 to 65		150 mm Copper Threaded Nipple and Union Rating: 250	150 mm Copper Threaded Nipple and Union Rating: 250	Threaded Copper Flange Rating: 125 RF	Threaded Copper Flange Rating: 150 RF				

PROCESS PIPE JOINTS AND EQUIPMENT CONNECTIONS

Table - Pipe Connections for Various Equipment End Types (continued)

Piping Material	Pipe Type	Diameter Range	Equipment End								
			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	Fiberglass Flanged	PVC Female Thread
PVC	SCH40	10 to 65									150mm 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				
	SCH80	10 to 65									150mm PVC Nipple and Union Rating: Schedule 80
		Greater than 65				PVC (SCH.80) Flange Rating: Class 125 FF	PVC (SCH.80) Flange Rating: Class 150 RF				
HDPE		10 to 65		150mm Galvanized Steel Nipple and Grooved Joint. Transition Coupling	150mm Galvanized Steel Nipple and Grooved Joint. Transition Coupling						
		Greater than 65				Stub End and Ductile Iron Backup Ring Rating: Class 125 FF	Stub End and Steel Backup Ring Rating: Class 150 RF				

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 44 00 50 – Process Piping

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

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

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Provide of Manitoba, Canada.

.2 Indicate on drawings:

.1 Mounting arrangements.

.2 Material of construction.

.3 Method of installation.

1.3 CLOSEOUT SUBMITTALS

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

.2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.

1.4 MAINTENANCE MATERIAL SUBMITTALS

.1 Submit in accordance with 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 - 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.

Part 2 Products

2.1 PIPE GUIDES AND ANCHORS

.1 Pipe guides

.1 Unless otherwise shown or specified, provide spider type. After fabrication hot dip galvanize. Provide AISI 304 stainless steel for submerged locations. Refer to the following pages and the Drawings for location.

.2 Acceptable manufacturers

.1 Grinnell Fig. 256

.2 B-Line Series B3281

.2 Anchors

.1 Unless otherwise shown or specified, provide hot dip galvanized materials.

.2 Provide AISI type 304 stainless steel materials in submerged locations.

.3 Provide AISI Type 304 stainless steel nuts, bolts, and washers.

2.2 PROCESS AIR PIPE GUIDES AND ANCHORS

.1 Provide PTFE lower bearing surfaces not less than 2.4 mm (3/32 inch) thick of 100 percent virgin material in accordance with ASTM D1457 and with a 25 percent 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 (1/8 inch) thick type 304 stainless steel with a 6.4 mm (1/4 inch) welding lip all around.

.3 Provide PTFE with minimum 20 MPa tensile strength, tested in accordance with ASTM D638; 200 percent elongation minimum, tested in accordance with ASTM D638; and 216 ± 0.03 relative density, tested in accordance with ASTM D792.

.4 Provide stainless steel components to ASTM A167; type 304.

.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 as manufactured by Amscot Structural Products, Piping Technology and Products, or approved equal, 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 Fabrication tolerances

.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 ±10 percent of the specified thickness

.7 Parallelism of one sliding surface with respect to the mating sliding surface, as datum, to 0.2 percent 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-centrer 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 3 microns.

.15 Remove abrasive materials from finished surfaces and clean with a degreasing agent.

.16 Protect finished surfaces from contamination and mechanical damage.

Part 3 Execution

3.1 PROCESS AIR PIPE GUIDES AND ANCHORS

.1 The Contractor shall, at his own cost, employ a Professional Engineer to design pipe anchors to control piping expansion and contraction for process chemical piping (ferric chloride and sodium hydroxide) and compressed air piping systems.

.2 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.

.3 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 done according to structural specifications in Division 3.

.4 Construct of fabricate as indicated in the Drawings or use approved commercial systems as indicated above.

3.2 CLEANING

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

.1 Leave Work area clean at end of each day.

3.3 PROTECTION

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 01 33 00 - Submittal Procedures

.2 01 78 00 - Closeout Submittals

.3 40 00 50 – Process Piping

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

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

.3 Shop Drawings:

.1 Indicate on drawings:

.1 Showing expansion joint details including maximum allowable temperature and pressure rating, overall face-to-face length measured at 15ºC, wall thickness, number of convolutions per joint, spring rate, maximum allowable axial, lateral and angular movement and materials of construction.

1.3 CLOSEOUT SUBMITTALS

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

.2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.

1.4 MAINTENANCE MATERIAL SUBMITTALS

.1 Submit in accordance with 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 - 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.

Part 2 Products

2.1 FUNCTION

.1 Expansion joints are used to compensate for thermal expansion and contraction in piping systems; 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 pipe 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. Process air may contain up to 20 ppm hydrogen sulphide.

.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 -40° 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.

.5 Acceptable manufacturers:

.1 Senior Flexonics

.2 Garlock

.3 Mercer

.4 Techniquip

.5 Elastomer, Spherical Moulded Type

.1 Construct of multiple plies of nylon tire cord fabric and elastomer suitable for specified commodity, temperature and pressure.

.2 Provide steel floating flanges, such that no metal parts come in contact with the fluid.

.3 Acceptable manufacturers:

.1 Senior Flexonics

.2 Garlock

.3 Mercer
.4 Techniquip
.5 Proco

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 percent 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.

.4 Acceptable manufacturers:

.1 Dresser
.2 Ford Meter Box
.3 Robar
.4 Rockwell

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. Do not provide flexible connectors on sump pump connection piping.

.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 less than 65 mm, or floating flange for pipe diameter greater than 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 centerline 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 Acceptable manufacturers for flexible hose connectors on piping systems up to and including 75 mm diameter are:

.1 American BOA
.2 Flex-Weld
.3 Senior Flexonics

.7 The design standard for flexible hose connectors on piping systems larger than 75 mm diameter is Senior Flexonics Type OF301 corrugated flexible metal hose connectors.

.8 Acceptable manufacturers for flexible connectors on piping systems larger than 75 mm diameter are:

.1 American BOA
.2 Flex-Weld
.3 Senior Flexonics

Part 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 week after commissioning.

3.2 FLEXIBLE HOSE CONNECTORS

.1 Accurately align pipelines to receive flexible connectors before installing the connectors.

.2 Do not stretch, compress, misalign, or offset the connectors.

.3 Align and install each flexible connector in accordance with the Manufacturer's instructions.

.4 Support, anchor, and guide the piping so that the flexible connectors are not required to absorb any axial compression or elongation.

.5 Do not torque or twist the flexible connectors.

.6 Check bolt tightness and tighten where necessary, a maximum of one week after commissioning and periodically thereafter.

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.

3.4 PROTECTION

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 01 33 00 - Submittal Procedures

.2 01 78 00 - Closeout Submittals

.3 40 00 50 – Process Piping

.4 LST-M-003 – Piping Service Specification Index

.5 40 40 00 - Process Piping Insulation

1.2 REFERENCES

.1 WSTP Building Mechanical Design Guideline, Rev 1

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

1.4 DELIVERY, STORAGE AND HANDLING

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

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

Part 2 Products

2.1 PROCESS FLUIDS AND PIPING MATERIALS

.1 Refer to LST-M-003 – Piping Service and Specification Index for summary.

2.2 SCHEDULE

.1 Refer to LST-M-003 Piping Service Spec Index.

Part 3 Execution

3.1 EXAMINATION

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

3.2 SYSTEM CLEANING

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

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.

3.4 PROTECTION

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

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 01 33 00 - Submittal Procedures

.2 01 78 00 - Closeout Submittals

.3 40 00 50 – Process Piping

.4 40 00 51 – Process Pipe Joints and Equipment Connections

1.2 REFERENCES

.1 ASTM International

.1 ASTM D1784 - Standard Classification System and Basis for Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

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.

.2 Submit shop drawings for:

.1 Equipment

.3 Certificates:

.1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Manufacturers' Instructions:

.1 Provide manufacturer's installation instructions.

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 Delivery and Acceptance Requirements:

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

Part 2 Products

2.1 INSTRUMENT AIR CONNECTIONS

.1 Provide instrument air connections to each instrument with a run of 12 mm stainless steel tubing from the nearest instrument air header to within close proximity of each device requiring instrument air.

.2 Terminate each tubing run with a 12 mm ball valve (stainless steel) within 1500 mm horizontal distance of the device and 1500 mm off the floor. Group multiple valves neatly together with a common orientation.

.3 Refer to Section 40 00 51 for connection from that termination to the device from the downstream side of the valve. A list of devices requiring instrument air is provided in the Instrument Specification Sheets.

.4 Provide a vertical riser connection at the header to avoid condensate entrainment. From the top of the riser, slope the tubing generally down to the device.

2.2 STRAINERS

.1 Air and Gas Strainers

.1 Provide strainers with Y-pattern, cast iron body, with 40 mesh Moel screens packed with Everdur wool. For copper piping, provide bronze bodies.

.2 Fit air line strainers with a brass blowoff cock.

.3 Acceptable manufacturers are:

.1 Armstrong

.2 Mueller

.3 Or approved equal as per B8.

.2 Steam and Water Strainers

.1 Provide steam and water strainers with Y-pattern unless otherwise specified.

.2 Provide carbon steel body for steam strainers, cast iron body for water strainers, and bronze bodies for copper piping systems.

.3 Provide 304 stainless steel screens and tapped and plugged blowoff connections.

.4 Screen perforations shall be 0.5 mm for steam service and 1.15 mm for water service.

.5 Acceptable manufacturers are:

.1 Armstrong

.2 Mueller

.3 Or approved equal as per B8.

.3 Ferric Chloride and Sodium Hydroxide Strainers

.1 Basket Strainers

.1 All thermoplastic Basket Strainers shall be fabricated from PVC Type I Cell Classification 12454 as per ASTM D1784. All O-rings shall be

EPDM. Strainer baskets shall be perforated PVC. Standard strainer perforation shall be 1/8" with a minimum open area ratio of 6:1, or specified perforation/mesh opening. Basket strainer shall have quick release clamp retained bonnet with safety nut, pressure release valve and safety pressure gauge. Unit shall be equipped with O-ring sealed drain plug at lower end. Basket strainer sizes 1/2" - 8" shall be pressure rated at 150 psi.

.2 Or approved equal as per B8.

.2 Wye Strainers

.1 All thermoplastic Wye Strainers shall be fabricated from PVC Type I Cell Classification 12454 as per ASTM D1784. All O-rings seal shall be EPDM. Strainer baskets shall be Titanium. Standard strainer perforation shall be 1/32" with a minimum open area ratio of 2:1, or specified perforation/mesh opening. Hex Cap for easy access to screen. Basket strainer sizes 1/2" - 8" shall be pressure rated at 150 psi.

.2 Or approved equal as per B8.

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 air service, acceptable products are:

.1 Dixon Air King

.2 Tomco, 12 mm diameter

.3 Or approved equal as per B8.

.3 For water service, provide products to Owner standard; two lug, malleable iron, female NPT. Sizes as shown. Acceptable products are: For water service, provide products to Owner standard. Sizes as shown. Acceptable products are:

.1 For hose 25 mm or less in diameter, two lug, malleable iron, female NPT: Dixon Air King

.2 For 38 mm and 50 mm diameter hose, two lug, malleable iron, female NPT: New Line

.3 For 75 mm and 100 mm diameter; quick-acting, dual clip: Rite-pro, Dixon.

.4 Or approved equal as per B8.

.4 For ferric chloride service, acceptable products are:

.1 Bay Seal

.2 Dixon Boss Lock

.3 PT Couplings

.4 Or approved equal as per B8.

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 percent.

.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 PURGE CONNECTIONS

.1 Provide purge connections on all gas lines.

.2 Locate adjacent to both sides of all isolation valves and spectacle flanges, and at any other locations shown in the Drawings.

.3 Purge points shall be a minimum of 20 mm NPS pipe, fitted with a shut-off valve, which shall be capped.

2.6 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.

.3 Acceptable products

.1 Gruvlock Clamp T
.2 Ford Service Saddles (F/FS)
.3 Victaulic Mechanical T
.4 Robar 2706 Service Saddles
.5 Or approved equal as per B8.

2.7 HOSES

.1 Provide hoses rated for 600 kPa, complete with quick connect fittings as per standard details and as called for on the Drawings.

2.8 FLOW CONTROL VALVE (HV-G0750B & HV-Y0790B)

.1 Basis of Design: Asahi / America Manual Plastic Constant Flow Valves or approved equal as per B8.

.2 Materials:

.1 U-PVC – Conforming to ASTM D1784 Cell Classification 12454 A
.2 EPDM – Ethylene Propylene Diene Terpolymer Rubber

.3 Valves:

.1 All Constant Flow Valves shall be of solid thermoplastic flanged body construction. 1/2" – 3/4" shall be inline design while 1” – 4” shall be Y type design. All Constant Flow valves shall have a calibrated flow dial and position indicator. Valve accuracy shall be +/- 6% of full scale. Internal valve spring shall be 304 SS with PCTFE coating.

.2 Target Flow: 250 LPH

.3 Seals: EPDM

.4 End Connections: Flanged

.4 Operators

.1 Handwheel operator valve handle red color.

.5 Pressure Vs. Temperature

.1 Valves shall have a pressure rating of 1034 kPa at 48°C all sizes

2.9 CHEMICAL INJECTION ASSEMBLY (INJ-D0811, INJ-D0812, INJ-D0771, INJ-D0831, INJ-G0751, & INJ-G0752)

.1 Basis of Design:

.1 Inyo Process or approved equal in accordance with B8.

.2 The chemical injection assembly shall be comprised of the following components:

.1 Manifold Assembly

.1 Material: PVC SCH 80 to CSA B137.3

.2 Manifold shall include one (1) main isolation valve (25mmØ) with a header system (25mmØ) connected to four (4) chemical injection titanium ball valves (15mmØ) with ferrule connections. Injection ball valves shall include ferrule end connections for attachment of PFA tubing with titanium compression fittings. Injection ball valve shall be spaced a minimum of 100mm apart on the header.

.1 Provide a minimum of 1.2m length of PFA tubing per injection ball valve with associated compressions fittings. Contractor shall field verify required length of tubing prior to ordering.

.3 Where applicable an eight (8) valve manifold assembly may substitute two four (4) valve manifold assemblies.

.2 Injection Wafer Disc

.1 Material: Polypropylene

.2 Gasket Material: Buna-N or EPDM

.3 Dimension of wafer shall match wastewater treatment piping system and not impose additional flow restriction to the system. Refer to P&IDs for piping system dimensions.

.4 Thickness of wafer component shall be 65mm minimum and incorporate four (4) injection points suitable for connection to 15mmØ titanium ferrule 90° elbow fittings. Each elbow fitting shall include a titanium 15mm ball valve. The injection points shall be equally spaced around the wafer.

.5 Wafer component shall include bolt holes to match up with the flanged spool assembly pattern.

.3 Flanged Spool Assembly

.1 Material: PVC SCH 80 to CSA B137.3

.2 Flanged spool assembly shall consist of both upstream and downstream sections for connection to the injection wafer disc.

.1 Upstream flanged spool assembly shall be a minimum of 600mm in length and incorporate a drain valve. Drain valve shall be a minimum of 50mmØ.

.2 Downstream flanged spool assembly shall be a minimum of 1500mm in length.

.3 Spool assembly shall have flanged connections and be suitable for 150PSI pressure rating. Gasket material shall be Buna-N or EPDM.

.4 Dimension of flanged spool assembly shall match wastewater treatment piping system and not impose additional flow restriction to the system. Refer to P&IDs for piping system dimensions.

.5 Contractor shall provide additional PVC SCH 80 piping in addition to the above noted flanged spool assembly to ensure the minimum upstream and downstream lengths of PVC SCH 80 piping are provided within the field to replace the existing wastewater treatment piping system.

.3 Vendor shall provide complete shop drawings indicating the configuration of the chemical injection assembly for review and approval by the Contract Administrator.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install in accordance with:

.1 Manufacturer's instructions and recommendations.

.2 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 copper tubing return. Take air vents to the nearest floor with the valve mounted in a location accessible from floor level and no greater than 1200 mm 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. 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 1200 mm 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.

3.3 CLEANING

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

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 01 33 00 - Submittal Procedures

.2 01 78 00 - Closeout Submittals

.3 40 00 50 – Process Piping

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B31.1-07, Power Piping.

.2 ASTM International

.1 ASTM A125-1996(2007), Standard Specification for Steel Springs, Helical, Heat Treated.

.2 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.3 ASTM A563-07a, Standard Specification for Carbon and Alloy Steel Nuts.

.3 Factory Mutual (FM)

.4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)

.1 MSS SP58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.

.2 MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.

.3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.

.5 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.

.2 Submit shop drawings for:

.1 Bases, hangers and supports.

.2 Connections to equipment and structure.

.3 Structural assemblies.

.3 Certificates:

.1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.4 Manufacturers' Instructions:

.1 Provide manufacturer's installation instructions.

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 Delivery and Acceptance Requirements:

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

Part 2 Products

2.1 SYSTEM DESCRIPTION

.1 Design Requirements:

.1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.

.2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.

.3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.

.4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.

.5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.

2.2 GENERAL

.1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP58.

.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.3 PIPE HANGERS

.1 Finishes:

.1 Pipe hangers and supports: galvanized after manufacture.

.2 Use hot dipped galvanizing process.

.3 Ensure steel hangers in contact with copper piping are copper plated.

.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: 13 mm FM approved.

.2 Cold piping NPS 2-1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed to MSS-SP58 and MSS-SP69.

.3 Upper attachment structural: suspension from upper flange of I-Beam:

.1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed to MSS SP69.

.2 Cold piping NPS 2-1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed.

.4 Upper attachment to concrete:

.1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.

.2 Concrete inserts: wedge shaped body with knockout protector plate UL listed to MSS SP69.

.5 Hanger rods: threaded rod material to MSS SP58:

.1 Ensure that hanger rods are subject to tensile loading only.

.2 Provide linkages where lateral or axial movement of pipework is anticipated.

.6 Pipe attachments: material to MSS SP58:

.1 Attachments for steel piping: carbon steel.

.2 Attachments for copper piping: copper plated black steel.

.3 Use insulation shields for hot pipework.

.4 Oversize pipe hangers and supports.

.7 Adjustable clevis: material to MSS SP69 UL listed, 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 SP69.

.9 U-bolts: carbon steel to MSS SP69 with two nuts at each end to ASTM A563.

.1 Finishes for steel pipework: black.

.2 Finishes for copper, glass, brass or aluminum pipework: galvanized, with formed portion plastic coated.

.10 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

2.4 RISER CLAMPS

.1 Steel or cast-iron pipe: black carbon steel to MSS SP58, type 42, UL listed.

.2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.

.3 Bolts: to ASTM A307.

.4 Nuts: to ASTM A563.

2.5 INSULATION PROTECTION SHIELDS

.1 Insulated cold piping:

.1 164 kg/m^3 density insulation plus insulation protection shield to: MSS SP69, 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 300 and over, carbon steel to comply with MSS SP69.

2.6 CONSTANT SUPPORT SPRING HANGERS

.1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR).

.2 Load adjustability: 10% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.

.3 Provide upper and lower factory set travel stops.

.4 Provide load adjustment scale for field adjustments.

.5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.

.6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.7 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 springs in series in single casing.

.3 Variable spring hanger complete with factory calibrated travel stops.

.4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.8 EQUIPMENT SUPPORTS

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

2.9 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

2.10 HOUSE-KEEPING PADS

.1 Provide 100 mm or 200mm high concrete housekeeping pads for base-mounted equipment; size pads 100 mm larger than equipment; chamfer pad edges.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Install in accordance with:

.1 Manufacturer's instructions and recommendations.

.2 Vibration Control Devices:

.1 Install on piping systems at pumps, boilers, chillers, cooling towers, and as indicated.

.3 Clamps on riser piping:

.1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
.2 Bolt-tightening torques to industry standards.
.3 Steel pipes: install below coupling or shear lugs welded to pipe.
.4 Cast iron pipes: install below joint.

.4 Clevis plates:

.1 Attach to concrete with 4 minimum concrete inserts, one at each corner.

.5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

.6 Use approved constant support type hangers where:

.1 Vertical movement of pipework is 13 mm or more,
.2 Transfer of load to adjacent hangers or connected equipment is not permitted.

.7 Use variable support spring hangers where:

.1 Transfer of load to adjacent piping or to connected equipment is not critical.
.2 Variation in supporting effect does not exceed 25 % of total load.

3.3 HANGER / SUPPORT SPACING

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

.2 Copper piping: up to NPS ½" (15mm): every 1.5 m.

.3 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.

.4 HDPE Chemical piping:

.1 Less than NPS 50mm: provide a continuous uni-strut channel (Design Basis: P1000) that is supported every 1.8m.

.2 NPS 50mm and Greater: provide pipe support every 1.2m

.5 PVC Chemical pressure piping:

Maximum Pipe Size : NPS	Maximum Spacing PVC (SCH 80)
up to 32	1.3 m
38	1.3 m
50	1.8 m
63	1.8 m
80	2.0 m
100	2.3 m

.6 Within 300 mm of each elbow.

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 32	2.4 m	1.8 m
38	3.0 m	2.4 m
50	3.0 m	2.4 m
63	3.7 m	3.0 m
80	3.7 m	3.0 m
100	3.7 m	3.6 m
125	4.3 m	
150	4.3 m	
200	4.3 m	
250	4.9 m	
300	4.9 m	

.7 Pipework greater than NPS 12: to MSS SP69.

3.4 HANGER INSTALLATION

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

.2 Adjust hangers to equalize load.

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

3.5 HORIZONTAL MOVEMENT

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

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

3.6 FINAL ADJUSTMENT

.1 Adjust hangers and supports:

.1 Ensure that rod is vertical under operating conditions.
.2 Equalize loads.

.2 Adjustable clevis:
.1 Tighten hanger load nut securely to ensure proper hanger performance.
.2 Tighten upper nut after adjustment.

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

.4 Beam clamps:
.1 Hammer jaw firmly against underside of beam.

3.7 CLEANING

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

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 01 33 00 - Submittal Procedures

.2 01 78 00 - Closeout Submittals

.3 40 00 50 – Process Piping

.4 40 01 25 – Process Valve and Gate Actuators

.5 LST-M-006 – Valve Specification Index

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

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

.3 Shop Drawings:

.1 Indicate on drawings:

.1 Catalogue cuts and 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 An amended Detailed Valve Specification Sheet for all valves. Indicate with check marks where the valve supplied meets the requirements specified and with written amendments where the Product differs from the Specification.

1.3 CLOSEOUT SUBMITTALS

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

.2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.

1.4 MAINTENANCE MATERIAL SUBMITTALS

.1 Submit in accordance with 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 - 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.

Part 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.

.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, 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 and pneumatic); FCV, LCV, PCV and XV only. Refer to the Drawings for abbreviation definitions.

.7 Specialty Valves; FV and PRV only. Refer to the Drawings for abbreviation definitions.

.8 Manual Isolation and Shut-off Valves; BF, BV, GL, GV, KV and PV only.

.9 Specific requirements for the materials, ratings and service conditions for each valve are listed in LST-M-006 – Valve Specification Index.

.10 Valves to open counter-clockwise.

2.2 DRAWINGS

.1 The process schematics indicate major process valves required for the process to operate as intended.

.2 The detailed process drawings and process standard drawings indicate the valves on the process schematics plus other valves required for isolation.

.3 In pipe runs less than 100 mm diameter, in addition to the valves indicated on the P&IDs, detailed drawings and standard drawings, provide isolation valves in straight pipe runs at intervals no greater than 60 m and at takeoffs to individual services. Provide ball isolation valves in pipe of 65 mm diameter and less, or in pipe of less than 100 mm diameter and carrying solids. Provide butterfly isolation valves in pipe of 75 mm diameter and greater and not carrying solids.

.4 In pipe runs carrying sludge or scum tap bottom of pipe at low point of runs and install short nipple and isolation valve.

.5 Provide valves and taps on top of pipe at high point in all liquid pipe runs greater than 60m length where the change in slope exceeds 4 percent.

.6 Provide flushing connections and valves as shown in standard details, at 30 m intervals on any primary sludge, primary and thickener scum and thickened secondary sludge lines.

.7 Unless otherwise specified, provide gate valves 400 mm and larger with a bypass valve sized in accordance with AWWA C500.

.8 Where a valve may be required for the process to function correctly or is required to satisfy fire and safety codes but it is not shown in the drawings, inform the Contract Administrator and provide details and suggestions for remedial action. Do not commence piping in the related pipe run until obtaining the Contract Administrator's approval.

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 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, mechanical drawings, or the Instrumentation Specification sheets.

.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 Handwheel 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
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 Gate Valves: less than 300 mm, hand wheel; equal to or greater than 300 mm, gear operator.

.2 Knife Gate Valves: less than 300 mm, hand wheel; equal to or greater than 300 mm, gear operator.

.3 Globe and Needle Valves: less than 200 mm, hand wheel; equal to or greater than 200 mm, gear operator.

.5 Match existing operating nuts. Provide two eight-point operating wrenches.

.6 Supply stem extensions and valve boxes for buried valves specified in the Drawings, Sections 11105, and in Clause 2.5 of this Section. Provide two operating tees.

.7 Lever operators to conform to the following dimensions:

Nominal Valve Diameter (mm)	Minimum Lever Length (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 positions. Provide butterfly valves with 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 Plug Valves and 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. Equip operators with adjustable mechanical stop-limiting devices to prevent overtravel of the disc or 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. Where gear operators are intended for direct bury or submergence, seal units with long life lubricant.

.12 Manual operators for butterfly and gate valves for buried service to include an AWWA operating nut and be gasketed and grease packed for submerged operation at water pressures to 700 kPa. Operators for exposed service shall be gasketed for weatherproof service. Place gear boxes above ground and liquid surfaces.

.13 Gear and manual operators for submerged service to be permanently lubricated and sealed for operation at water pressures to 700 kPa.

.14 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 150 N 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 VALVE STEM EXTENSIONS

.1 Provide valve stem extensions where additional clearance is required for pipe insulation, where valve operation without the extension is difficult, and in manholes.

.2 Where angle valve stem extensions are employed, they shall be angle geared. Universal joint types are not permitted.

2.6 INSULATION

.1 In insulated pipe runs, insulate valves.

.2 Preform insulation in a shape suitable for the valve, with the same material of the main pipe.

.3 Insulation to be removable and reusable without destroying insulation or recovering.

2.7 PROTECTIVE COATINGS

.1 Unless otherwise specified, provide valves coated with same material of the main pipe coating.

2.8 CATHODIC PROTECTION

.1 Unless otherwise specified, provide cathodic protection to underground valves.

2.9 SPARE PARTS

.1 Provide one 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 years. At the Contract Administrator's request, provide a price for these parts.

Part 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 Work.

.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 provide suitable access to manual operators and that sufficient space and accessibility is available for pneumatic and 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 Install valves in conjunction with the piping and with control valves and their appurtenances.

.2 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. In no case install a valve with the operator shaft pointing down.

.3 Mount butterfly valves and trunnion ball valves with the shaft in a horizontal orientation.

.4 When joining valves to pipe or fittings, do not over torque 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 greater 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 gate valves in the closed position.

.10 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.

.11 Unless otherwise specified, install single seated ball valves and knife gate 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.

.12 Install all valves in accordance with the Manufacturer's recommendations.

.13 Protect valves installed below grade with a shrink sleeve or polyethylene sheath attached to the pipe with tapewrap.

3.3 VALVE EXTENSIONS

.1 Install valve stem extensions where necessary to provide clearance from insulation.

3.4 VALVE TESTING

.1 Operate valves under simulated and/or real process conditions to ensure they operate as intended.

.2 Pressure test the valves in conjunction with the pipes in which the valves are installed.

3.5 CLEANING

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

.1 Leave Work area clean at end of each day.

3.6 PROTECTION

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 01 33 00 - Submittal Procedures

.2 01 78 00 - Closeout Submittals

.3 40 01 25 – Process Valves

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

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

.3 Shop Drawings:

.1 Indicate on drawings:

.1 Calculations indicating the operating torque of the valve or gate for which the actuator is to be supplied.

.2 The torque rating of the actuator.

1.3 CLOSEOUT SUBMITTALS

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

.2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.

1.4 MAINTENANCE MATERIAL SUBMITTALS

.1 Submit in accordance with 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 - 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.

Part 2 Products

2.1 GENERAL

.1 Provide new, unused actuators for the work.

.2 Use materials for actuators that are free from defects or flaws.

.3 Tag actuators to indicate operating characteristics and inlet and outlet ports for electric or pneumatic services.

.4 Standard of acceptance for all on/off electric actuators shall be Rotork.

.5 Provide actuators with mechanical position indicators

2.2 DRAWINGS

.1 Review and verify piping and instrumentation drawings (P&IDs), ensuring that they indicate all valves and automatic actuators that are critical to proper process operation. Where valves or actuators are not indicated, inform Contract Administrator.

2.3 MANUAL ACTUATORS

.1 Provide valves with manual actuators unless indicated otherwise in other specification sections or shown on the process and instrumentation drawings.

.2 For manual actuators located more than 1830 mm above the floor, provide chain operators.

2.4 ELECTRIC ACTUATORS, OPEN/CLOSE, QUARTER TURN, LESS THAN 1,000 N-M TORQUE

.1 Use electric operators that are suitable for mounting on quarter turn valves intended for on/off service.

.2 For actuators rated at less than or equal to 100 Nm, incorporate a 120 V, 1 phase, 60 Hz motor. For actuators rated at greater than 500 Nm and less than or equal to 1,000 Nm, use a 208 V, 3 phase, 60 Hz motor. In each case, use motors that are high torque, reversible.

.3 Use motors that are rated for continuous duty, as defined in the appropriate NEMA standard.

.4 Incorporate thermal overload devices in motor windings to protect the motor against overheating.

.5 Unless noted otherwise, design the actuators to fail to the last position when the control function or power fails.

.6 Fit each actuator with a hand wheel that will enable manual override control of the valve. Incorporate a method of ensuring that when the manual override is engaged, motor driven operation is precluded.

.7 Make each actuator capable of operating in any horizontal or vertical orientation.

.8 Provide external mechanical indication of valve position.

.9 House internal components in a NEMA 4X enclosure, waterproof and moisture resistant and corrosion-resistant, and permanently lubricated. Use stainless steel connectors for all exposed connections.

.10 For actuator drive train, use steel or aluminum gears arranged with worm gears or compound gear assembly. Design gears in accordance with AGMA standards for heavy duty, intermittent service. Ensure that geared drive train can withstand locked rotor conditions. Incorporate bearings designed with an ABFMA B10 life in excess of 40,000 hours.

.11 Use gears and bearings that are non-lubricated or permanently lubricated.

.12 In each actuator, incorporate two SPDT travel limit switches, 10 A, 120 VAC, CSA listed.

.13 The travel limit switches shall each be adjustable.

.14 In each actuator, incorporate two SPDT torque limit switches, 10 A, 120 VAC. Make the torque limit switches factory pre-set and field adjustable.

.15 Provide mechanical limit stops, adjustable, to ensure over-turning of the valve door does not occur.

.16 Protect exterior mounted actuators against high temperature and condensation.

.17 Design the actuator so that the opening and closing speed is field adjustable.

.18 Provide a terminal board for field wiring. Include contacts to indicate the open/closed status of the valve, overheating alarm, and overtorque alarms.

.19 Refer to motorized valve datasheets for actuator selections.

2.5 VALVE POSITIONERS

.1 When specified on the instrument specification sheets supply compatible positioners pre-mounted to each actuator. Do not mount the positioner upside down.

.2 Each positioner to service the entire operating range of the actuator. The equipment position shall be fed back to the positioner through a mechanical linkage.

.3 Positioner to operate with instrument quality, oil-free control air.

.4 Provide three independent, interchangeable cams for each positioner-linear function, square function, and square root function.

.5 Mount a pressure gauge on the positioner to measure air output.

2.6 POSITION SWITCHES AND INDICATORS

.1 When specified on the Instrument Specification Sheets, supply actuator assemblies pre-mounted with external position monitors which include two (2) cam actuated “GO” Form C rated proximity switches, a 5-pole male receptacle, a polycarbonate dome beacon and an EEMAC 4 (minimum) enclosure.

.2 Cams to be fastened to a splined shaft and adjustable without set screws.

.3 Provide a visual indicator with beacon type display showing red when the controlled device is in the closed position, and green in the open position.

.4 Supply all required hardware for mounting of position monitor in accordance with the specified valve and actuator orientation.

.5 Diaphragm actuated valves to have external position monitor actuated through linkages.

.6 Enclosures to be suitable for environment to which they are exposed.

2.7 MANUAL LOADING STATION

.1 Manual loading station shall consist of a manually adjustable loading regulator, changeover valve (manual/automatic), a gauge for manual signal pressure indication, a gauge for automatic signal pressure indication, an air set, and air supply isolation valve.

.2 Mount loading station on a galvanized plate attached to a floor stand. Locate station within 2 m of the controlled device.

2.8 FINISHES

.1 Actuators shall be shop finished.

Part 3 Execution

3.1 PREPARATION

.1 Prior to the installation of the actuators, field measure and check all equipment locations, pipe alignments, and structural installations. Ensure that the valve location and orientation provide suitable access to manual actuators and that sufficient space and accessibility is available for maintenance and to allow unobstructed view of operation and position of pneumatic and electric actuators.

.2 Where conflicts are identified, inform the Contract Administrator and initiate the necessary piping modifications.

3.2 INSTALLATION TRAINING

.1 .1 Inform the installer of all procedures and requirements necessary for the successful installation of the equipment. Attest to the installer's understanding by completing Form 101.

3.3 INSTALLATION

.1 Ensure the equipment is installed as required to provide satisfactory service.

.2 Cooperate with the installer to fulfill the requirements for a successful installation, as documented by Form 102.

3.4 TESTING

.1 Ensure the equipment, including all component parts, operates as intended. Testing includes field verification of operating speed and torque outputs at rated operating conditions.

.2 Cooperate with the installer to fulfill the requirements for successful testing of the equipment as documented by Form 103.

3.5 CLEANING

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

.1 Leave Work area clean at end of each day.

3.6 PROTECTION

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 01 33 00 - Submittal Procedures

.2 01 78 00 - Closeout Submittals

.3 Section 40 00 05 – General Process Provisions

.4 Pump Datasheets

.1 DST-P-F0770, P-F0771, P-F0772
.2 DST-P-F0780, P-F0781
.3 DST-P-F0830, P-F0831, P-F0832
.4 DST-P-G0751
.5 DST-P-Y0791, P-Y0792, P-Y0793

1.2 REFERENCE STANDARDS

.1 NSF Services Canada

.1 NSF/ANSI/CAN 61 – Certification for Your Drinking Water Components.

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

.3 Shop Drawings:

.1 Indicate on drawings:
.1 Mounting arrangements.
.2 Operating and maintenance clearances.

.2 Shop drawings and product data accompanied by:
.1 Detailed drawings of bases, supports, and anchor bolts.
.2 Points of operation on performance curves.
.3 Manufacturer to certify current model production.
.4 Section drawing indicating connections
.5 Drawing dimensions

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with 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 - 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.

Part 2 Products

2.1 FERRIC CHLORIDE METERING PUMPS

.1 Description

.1 Equipment to be capable of pumping ferric chloride.

.2 The system includes metering pumps, strainers, controls, calibration column, backpressure valves, pressure relief valves, ball valves, pressure gauges, high pressure switches, check valves, magnetic flow meters, and all associated piping and fittings, in accordance with the Drawings.

.3 The whole system shall take into account the specific gravity, viscosity, corrosivity and temperature of the fluid being pumped.

.2 Tag Numbers

.1 P-F0770

.2 P-F0771

.3 P-F0772

.3 Design Standard

.1 Pulsafeeder (Eclipse)

.4 Acceptable Manufacturers

.1 Pulsafeeder Engineered Products

.2 or approved equal in accordance with B8.

.5 Capacities and Performance

.1 Ferric chloride: 37 to 42%, Specific Gravity of 1.39 to 1.46

.2 Design pumps to handle abrasive crystals that may form in the solution.

.3 Fluid temperature: 5°C to 35°C

.4 Gear Pumps

.1 Number of pumps: 3

.2 Minimum capacity, each: 8 L/hr.

.3 Maximum capacity, each: 400 L/hr.

.4 Maximum backpressure: 400 kPa

.5 Maximum positive suction pressure: 65 kPa (chemical storage tank full).

.6 Maximum negative suction pressure: 50 kPa (chemical storage tank empty).

.7 Maximum differential pressure: 450 kPa

.6 Materials

.1 Fabricate pumps of titanium or Polyvinylidene Fluoride (PVDF).

.2 Fabricate pipes and valves of PVC

.3 Fabricate skid of fibre reinforced plastic (FRP) or black PVC.

.7 Strainers

.1 Provide an inline suction strainer for each metering pump. Use material appropriate for the chemicals being pumped.

.2 Provide flanged Y-type strainers complete with removable plastic 1.5 mm screen and Teflon seals.

.8 Calibration Chamber

.1 Provide 4000 mL calibration cylinder suitable for the chemicals with scale in mL on the side and ball isolation valve for connection to the suction line of each metering pump. Provide column of clear PVC or a translucent material suitable for the chemical application. Do not provide glass cylinders.

.9 Gear Pumps

.1 Provide positive displacement seal-less magnetically driven external gear type metering pumps designed to meet the specified flow ranges when pumping the specified materials. Pumping rate change shall be accomplished by varying the pump operating speed.

.2 Include hydraulic relief valves to protect pumps against overpressure. Set valves according to Manufacturer's recommendations. Fabricate of materials resistant to corrosive chemicals used.

.3 Provide high pressure switches on the discharge of each pump.

.4 The pumps shall provide a constant flow rate for a particular drive speed and provide linear pulsation-free output flow at all chemical liquid level in storage tanks.

.5 The driven magnet shall be an encapsulated assembly mounted on the end of the pump shaft. The drive magnet assembly shall rotate around the containment can as a result of the magnetic force.

.6 The pumps shall have a pumping accuracy of +5 percent of the full range.

.7 Combined pump, motor and variable frequency controller system shall be capable of providing a 100:1 turndown ratio.

.8 Construct the pump parts in contact with the chemical being pumped from materials suitable for the chemical application. Construct the pump of the following materials:

.1 Pumps: hardened titanium construction

.2 Wear plates: ceramic

.3 Shafts: ceramic

.4 Gears: Teflon or Ryton

.9 Provide pressure relief valve and backpressure regulating valve for each pump discharge, sized for the maximum pump flow with an adjustable pressure range. Valve material to be compatible with the chemical being pumped.

.10 Provide pumps suitable for connection to variable speed drive.

.11 Provide motors suitable for variable speed operation refer to Section 26 29 23. Motors shall include position feedback encoder for closed loop speed control, compatible with supplied variable frequency drive.

.12 Motors to be designated IEEE Chemical Industry - Severe Duty TEFC (CISD-TEFC).

.13 Provide local control for each pump, complete with speed indicator, manual speed control, computer-off-hand, selector, lock-off-stop pushbutton, start/stop switch, and power disconnect switch.

.14 Provide variable speed drives, in accordance with Section 26 29 23, capable of producing the required torque and power to operate the pumps over the entire speed range required to match specified dose rates.

.15 Provide drives suitable for 208 V/3 phase/60 Hz power supply.

.16 Provide drives suitable for local fixed speed or remote variable speed control, from remote 4-20 mA DC input signals.

.17 Provide a floor-mounted support frame for the skid assembly. Fabricate support frame of chemically resistant fibre reinforced plastic (FRP) or chemically resistant black PVC. Provide sufficient strength to allow the support frame to carry the full weight of all of the skid components when full of chemical.

.10 Piping and Valves

.1 Provide Schedule 80 PVC piping and flanges in accordance with Sections 40 00 50, 40 00 51 and 40 00 55. Provide flanges on the inlet and outlets to the skid.

.2 Provide valves and appurtenances of material suitable for the specified chemicals, in accordance with Sections 40 01 00, and 40 01 25.

.3 Provide instrumentation and flow meters in accordance with the document LST-E-002.

.4 Isolation valves to be ball valves. Refer to Section 40 01 00, BV06 for details.

.5 Check valves to be PVC ball check valves with Viton seats, rated for 150 psi.

.6 Valves to be Chemline, Hayward “True Check”, or equivalent.

.7 Pressure relief valves to be PVC with Viton seals, with no external metal fasteners and have corrosion resistant coated internal spring to cover the valve’s entire set pressure range. Valves to be hand adjustable without tools. Valve to relieve pressure in the range 5 to 75 psi. Valves to be Chemline, Hayward, or equivalent.

.8 Back-pressure regulating valves to have Viton seals. Provide Chemline SB12 or equivalent.

.11 Control Panel

.1 Provide remotely-mounted variable frequency drive control panels and remotely-mounted control stations for the pump skid. The panels and control stations are to include pump speed controls and all features necessary for the system to operate as described and to permit the system to operate on remote automatic control or on local or remote manual control.

.2 Each control panel to include the following:

.1 Variable frequency drives, transformer, relays, line reactors, fused disconnect, wireway-lamacoid nameplates, etc.

.2 Each panel to be suitable for 208 V, 3 phase, 60 Hz power supply.

.3 Factory finished NEMA 4X, 316 stainless steel enclosures to house all required components. Provide enclosure with a hinged, lockable front face. Provide

accessories to mount the panel at a suitable operating height. Mount all indicators, hand switches, contacts, etc, on the panel face.

.4 Provide the following for each pump:

.1 One Computer-Off-Hand switch
.2 One Lock-Off-Stop switch
.3 One Speed Controller (key pad)
.4 One Alarm Reset push-button
.5 One RED-ON/GREEN-OFF light.

.5 Provide voltage free form C contacts for all digital points and optically isolated connections for all analogue points in accordance with the Drawings.

.6 Terminate all connections to external wiring inside the panel at 208 V terminal strip for connection to wiring by Division 26.

.12 Control Description

.1 When required, the gear pump system is turned on manually. The pumps are switched on through a power disconnect switch in the local panel. Each injection point has a dedicated metering pump system.

.2 Automatic control sets the chemical dose in response to a 4-20 mA signal, which is used to vary the pump drive speed.

.3 The three lines from the metering pumps cross connect to discharge to injection points.

.13 Painting

.1 Shop prime and paint equipment in accordance with Section 09 91 12.

.2 All metal surface including frames shall be coated with chemical-resistant coating.

.14 Spare Parts and Maintenance Materials

.1 Provide one complete spare pump including motor for use as a shelf standby.

.2 Provide the following spare parts:

.1 Three (3) service sets (including gears, shoes, bearings (if required) and O– rings).
.2 Three (3) sets of ceramic wear parts.
.3 Three (3) backpressure valve diaphragms.
.4 Three (3) pressure relief valve diaphragms.
.5 Three (3) strainers

.3 Provide a list of spare parts which would be expected to be required over a period of five years under normal conditions. At the Contract Administrator's request, provide a price for the listed parts.

2.2 FERRIC CHLORIDE TRANSFER PUMPS

.1 Description

.1 Equipment to be capable of pumping ferric chloride.

.2 The system includes transfer pumps, strainers, controls, calibration column, backpressure valves, pressure relief valves, ball valves, pressure gauges, high pressure switches, check valves, magnetic flow meters, and all associated piping and fittings, in accordance with the Drawings.

.3 The whole system shall take into account the specific gravity, viscosity, corrosivity and temperature of the fluid being pumped.

.2 Tag Numbers

.1 P-F0780

.2 P-F0781

.3 Design Standard

.1 Pulsafeeder (Eclipse)

.4 Acceptable Manufacturers

.1 Pulsafeeder Engineering Products or approved equal as per B8.

.5 Capacities and Performance

.1 Ferric chloride: 37 to 42%, Specific Gravity of 1.39 to 1.46

.2 Design pumps to handle abrasive crystals that may form in the solution.

.3 Fluid temperature: 5°C to 35°C

.4 Gear Pumps

.1 Number of pumps: 2

.2 Minimum capacity, each: 8 L/hr.

.3 Maximum capacity, each: 400 L/hr.

.4 Maximum backpressure: 400 kPa

.5 Maximum positive suction pressure: 65 kPa (chemical storage tank full).

.6 Maximum negative suction pressure: 50 kPa (chemical storage tank empty).

.7 Maximum differential pressure: 450 kPa

.6 Materials

.1 Fabricate pumps of titanium or Polyvinylidene Fluoride (PVDF).

.2 Fabricate pipes and valves of PVC

.3 Fabricate skid of fibre reinforced plastic (FRP) or black PVC

.7 Strainers

.1 Provide an inline suction strainer for each metering pump. Use material appropriate for the chemicals being pumped.

.2 Provide flanged Y-type strainers complete with removable plastic 1.5 mm screen and Teflon seals.

.8 Gear Pumps

.1 Provide positive displacement seal-less magnetically driven external gear type metering pumps designed to meet the specified flow ranges when pumping the specified materials. Pumping rate change shall be accomplished by varying the pump operating speed.

.2 Include hydraulic relief valves to protect pumps against overpressure. Set valves according to Manufacturer’s recommendations. Fabricate of materials resistant to corrosive chemicals used.

.3 Provide high pressure switches on the discharge of each pump.

.4 The pumps shall provide a constant flow rate for a particular drive speed and provide linear pulsation-free output flow at all chemical liquid level in storage tanks.

.5 The driven magnet shall be an encapsulated assembly mounted on the end of the pump shaft. The drive magnet assembly shall rotate around the containment can as a result of the magnetic force.

.6 The pumps shall have a pumping accuracy of +5 percent of the full range.

.7 Combined pump, motor and variable frequency controller system shall be capable of providing a 100:1 turndown ratio.

.8 Construct the pump parts in contact with the chemical being pumped from materials suitable for the chemical application. Construct the pump of the following materials:

.1 Pumps: hardened titanium construction

.2 Wear plates: ceramic

.3 Shafts: ceramic

.4 Gears: Teflon or Ryton

.9 Provide pressure relief valve and backpressure regulating valve for each pump discharge, sized for the maximum pump flow with an adjustable pressure range. Valve material to be compatible with the chemical being pumped.

.10 Provide pumps suitable for connection to variable speed drive.

.11 Provide motors suitable for variable speed operation refer to Section 26 29 23. Motors shall include position feedback encoder for closed loop speed control, compatible with supplied variable frequency drive.

.12 Motors to be designated IEEE Chemical Industry - Severe Duty TEFC (CISD-TEFC).

.13 Provide local control for each pump, complete with speed indicator, manual speed control, computer-off-hand, selector, lock-off-stop pushbutton, start/stop switch, and power disconnect switch.

.14 Provide variable speed drives, in accordance with Section 26 29 23, capable of producing the required torque and power to operate the pumps over the entire speed range required to match specified dose rates.

.15 Provide drives suitable for 208 V/3 phase/60 Hz power supply.

.16 Provide drives suitable for local fixed speed or remote variable speed control, from remote 4-20 mA DC input signals.

.17 Provide a floor-mounted support frame for the skid assembly. Fabricate support frame of chemically resistant fibre reinforced plastic (FRP) or chemically resistant black PVC. Provide sufficient strength to allow the support frame to carry the full weight of all of the skid components when full of chemical.

.9 Piping and Valves

.1 Provide Schedule 80 PVC piping and flanges in accordance with Sections 40 00 50, 40 00 51 and 40 00 55. Provide flanges on the inlet and outlets to the skid.

.2 Provide valves and appurtenances of material suitable for the specified chemicals, in accordance with Sections 40 01 00, and 40 01 25.

.3 Provide instrumentation and flow meters in accordance with the document LST-E-002.

.4 Isolation valves to be ball valves. Refer to Section 40 01 00, BV06 for details.

.5 Check valves to be PVC ball check valves with Viton seats, rated for 150 psi.

.6 Valves to be Chemline, Hayward “True Check”, or equivalent.

.7 Pressure relief valves to be PVC with Viton seals, with no external metal fasteners and have corrosion resistant coated internal spring to cover the valve's entire set pressure range. Valves to be hand adjustable without tools. Valve to relieve pressure in the range 5 to 75 psi. Valves to be Chemline, Hayward, or equivalent.

.8 Back-pressure regulating valves to have Viton seals. Provide Chemline SB12 or equivalent.

.10 Control Panel

.1 Provide remotely-mounted variable frequency drive control panels and remotely-mounted control stations for the pump skid. The panels and control stations are to include pump speed controls and all features necessary for the system to operate as described and to permit the system to operate on remote automatic control or on local or remote manual control.

.2 Each control panel to include the following:

.1 Variable frequency drives, transformer, relays, line reactors, fused disconnect, wireway-lamacoid nameplates, etc.

.2 Each panel to be suitable for 208 V, 3 phase, 60 Hz power supply.

.3 Factory finished NEMA 4X, 316 stainless steel enclosures to house all required components. Provide enclosure with a hinged, lockable front face. Provide accessories to mount the panel at a suitable operating height. Mount all indicators, hand switches, contacts, etc., on the panel face.

.4 Provide the following for each pump:

.1 One Computer-Off-Hand switch

.2 One Lock-Off-Stop switch

.3 One Speed Controller (key pad)

.4 One Alarm Reset push-button

.5 One RED-ON/GREEN-OFF light.

.5 Provide voltage free form C contacts for all digital points and optically isolated connections for all analogue points in accordance with the Drawings.

.6 Terminate all connections to external wiring inside the panel at 208 V terminal strip for connection to wiring by Division 26.

.11 Control Description

.1 When required, the gear pump system is turned on manually. The pumps are switched on through a power disconnect switch in the local panel.

.2 Automatic control sets the chemical dose in response to a 4-20 mA signal, which is used to vary the pump drive speed.

.12 Painting

.1 Shop prime and paint equipment in accordance with Section 09 91 12.

.2 All metal surface including frames shall be coated with chemical-resistant coating.

.13 Spare Parts and Maintenance Materials

.1 Provide one complete spare pump including motor for use as a shelf standby.

.2 Provide the following spare parts:

.1 Two (2) service sets (including gears, shoes, bearings (if required) and O– rings).
.2 Two (2) sets of ceramic wear parts.
.3 Two (2) backpressure valve diaphragms.
.4 Two (2) pressure relief valve diaphragms.
.5 Two (2) strainers

.3 Provide a list of spare parts which would be expected to be required over a period of five years under normal conditions. At the Contract Administrator's request, provide a price for the listed parts.

2.3 FERRIC CHLORIDE DOSING TANK AND METERING PUMP FOR DOSING POINT 2.1A/B

.1 Description

.1 Equipment to be capable of pumping ferric chloride.
.2 The system includes diaphragm metering pumps, strainers, controls, calibration column, backpressure valves, pressure relief valves, ball valves, pressure gauges, high pressure switches, check valves, and all associated piping and fittings, in accordance with the Drawings.
.3 The whole system shall take into account the specific gravity, viscosity, corrosivity and temperature of the fluid being pumped.

.2 Tag Numbers

.1 P-G0751

.3 Design Standard

.1 Prominent

.4 Acceptable Manufacturers

.1 Prominent
.2 Meunier Technologies
.3 Or approved equal as per B8.

.5 Capacities and Performance

.1 Ferric chloride: 37 to 42%, Specific Gravity of 1.39 to 1.46
.2 Design pumps to handle abrasive crystals that may form in the solution.
.3 Fluid temperature: 5°C to 35°C
.4 Diaphragm Pump
.1 Number of pumps: 1
.2 Minimum capacity, each: 8 L/hr.
.3 Maximum capacity, each: 400 L/hr.
.4 Maximum backpressure: 400 kPa
.5 Maximum positive suction pressure: 65 kPa (chemical storage tank full).
.6 Maximum negative suction pressure: 50 kPa (chemical storage tank empty).
.7 Maximum differential pressure: 450 kPa

.6 Materials

.1 Fabricate pipes and valves of PVC

.2 Fabricate skid of fibre reinforced plastic (FRP) or black PVC

.7 Strainers

.1 Provide an inline suction strainer for each metering pump. Use material appropriate for the chemicals being pumped.

.2 Provide flanged Y-type strainers complete with removable plastic 1.5 mm screen and Teflon seals.

.8 Diaphragm Pumps

.1 Provide positive displacement diaphragm type metering pumps designed to meet the specified flow ranges when pumping the specified materials. Pumping rate change shall be accomplished by varying the pump operating speed.

.2 Include hydraulic relief valves to protect pumps against overpressure. Set valves according to Manufacturer's recommendations. Fabricate of materials resistant to corrosive chemicals used.

.3 Provide high pressure switches on the discharge of each pump.

.4 The pumps shall provide a constant flow rate for a particular drive speed and provide linear pulsation-free output flow at all chemical liquid level in storage tanks.

.5 The pumps shall have a pumping accuracy of +5 percent of the full range.

.6 Combined pump, motor and variable frequency controller system shall be capable of providing a 100:1 turndown ratio.

.7 Construct the pump parts in contact with the chemical being pumped from materials suitable for the chemical application.

.8 Provide pressure relief valve and backpressure regulating valve for each pump discharge, sized for the maximum pump flow with an adjustable pressure range. Valve material to be compatible with the chemical being pumped.

.9 Provide pumps suitable for connection to variable speed operation.

.10 Provide motors suitable for variable speed operation refer to Section 26 29 23. Motors shall include position feedback encoder for closed loop speed control, compatible with supplied variable frequency drive.

.11 Motors to be designated IEEE Chemical Industry - Severe Duty TEFC (CISD-TEFC).

.12 Provide local control for each pump, complete with speed indicator, manual speed control, computer-off-hand, selector, lock-off-stop pushbutton, start/stop switch, and power disconnect switch.

.13 Provide drives suitable for 120 V/1 phase/60 Hz power supply.

.14 Provide drives suitable for local fixed speed or remote variable speed control, from remote 4-20 mA DC input signals.

.15 Provide a floor-mounted support frame for the skid assembly. Fabricate support frame of chemically resistant fibre reinforced plastic (FRP) or chemically resistant black PVC. Provide sufficient strength to allow the support frame to carry the full weight of all of the skid components when full of chemical.

.9 Piping and Valves

.1 Provide Schedule 80 PVC piping and flanges in accordance with Sections 40 00 50, 40 00 51 and 40 00 55. Provide flanges on the inlet and outlets to the skid.

.2 Provide valves and appurtenances of material suitable for the specified chemicals, in accordance with Sections 40 01 00, and 40 01 25.

.3 Provide instrumentation and flow meters in accordance with the document LST-E-002.

.4 Isolation valves to be ball valves. Refer to Section 40 01 00, BV06 for details.

.5 Check valves to be PVC ball check valves with Viton seats, rated for 150 psi.

.6 Valves to be Chemline, Hayward “True Check”, or equivalent.

.7 Pressure relief valves to be PVC with Viton seals, with no external metal fasteners and have corrosion resistant coated internal spring to cover the valve’s entire set pressure range. Valves to be hand adjustable without tools. Valve to relieve pressure in the range 5 to 75 psi. Valves to be Chemline, Hayward, or equivalent.

.8 Back-pressure regulating valves to have Viton seals. Provide Chemline SB12 or equivalent.

.10 Painting

.1 Shop prime and paint equipment in accordance with Section 09 91 12.

.2 All metal surface including frames shall be coated with chemical-resistant coating.

.11 Spare Parts and Maintenance Materials

.1 Provide one complete spare pump including motor for use as a shelf standby.

.2 Provide the following spare parts:

.1 Two (2) service sets (including bearings (if required) and O– rings).

.2 Two (2) backpressure valve diaphragms.

.3 Two (2) pressure relief valve diaphragms.

.4 Two (2) strainers

.3 Provide a list of spare parts which would be expected to be required over a period of five years under normal conditions. At the Contract Administrator’s request, provide a price for the listed parts.

2.4 FERRIC CHLORIDE DOSING TANK AND METERING PUMP FOR DOSING POINT 4.1, 4.2 & 4.3

.1 Description

.1 Equipment to be capable of pumping ferric chloride.

.2 The system includes metering pumps, strainers, controls, calibration column, backpressure valves, pressure relief valves, ball valves, pressure gauges, high pressure switches, check valves, and all associated piping and fittings, in accordance with the Drawings.

.3 The whole system shall take into account the specific gravity, viscosity, corrosivity and temperature of the fluid being pumped.

.2 Tag Numbers

.1 P-Y0791

.2 P-Y0792

.3 P-Y0793

.3 Design Standard

.1 Prominent

.4 Acceptable Manufacturers

.1 Prominent

.2 Meunier Technologies

.3 Or approved equal as per B8.

.5 Capacities and Performance

.1 Ferric chloride: 37 to 42%, Specific Gravity of 1.39 to 1.46

.2 Design pumps to handle abrasive crystals that may form in the solution.

.3 Fluid temperature: 5°C to 35°C

.4 Gear Pumps

.1 Number of pumps: 3

.2 Minimum capacity, each: 8 L/hr.

.3 Maximum capacity, each: 400 L/hr.

.4 Maximum backpressure: 400 kPa

.5 Maximum positive suction pressure: 65 kPa (chemical storage tank full).

.6 Maximum negative suction pressure: 50 kPa (chemical storage tank empty).

.7 Maximum differential pressure: 450 kPa

.6 Materials

.1 Fabricate pipes and valves of PVC

.2 Fabricate skid of fibre reinforced plastic (FRP) or black PVC

.7 Strainers

.1 Provide an inline suction strainer for each metering pump. Use material appropriate for the chemicals being pumped.

.2 Provide flanged Y-type strainers complete with removable plastic 1.5 mm screen and Teflon seals.

.8 Diaphragm Pumps

.1 Provide positive displacement diaphragm type metering pumps designed to meet the specified flow ranges when pumping the specified materials. Pumping rate change shall be accomplished by varying the pump operating speed.

.2 Include hydraulic relief valves to protect pumps against overpressure. Set valves according to Manufacturer’s recommendations. Fabricate of materials resistant to corrosive chemicals used.

.3 Provide high pressure switches on the discharge of each pump.

.4 The pumps shall provide a constant flow rate for a particular drive speed and provide linear pulsation-free output flow at all chemical liquid level in storage tanks.

.5 The pumps shall have a pumping accuracy of +5 percent of the full range.

.6 Combined pump, motor and variable frequency controller system shall be capable of providing a 100:1 turndown ratio.

.7 Construct the pump parts in contact with the chemical being pumped from materials suitable for the chemical application.

.8 Provide pressure relief valve and backpressure regulating valve for each pump discharge, sized for the maximum pump flow with an adjustable pressure range. Valve material to be compatible with the chemical being pumped.

.9 Provide pumps suitable for connection to variable speed operation.

.10 Provide motors suitable for variable speed operation refer to Section 26 29 23. Motors shall include position feedback encoder for closed loop speed control, compatible with supplied variable frequency drive.

.11 Motors to be designated IEEE Chemical Industry - Severe Duty TEFC (CISD-TEFC).

.12 Provide local control for each pump, complete with speed indicator, manual speed control, computer-off-hand, selector, lock-off-stop pushbutton, start/stop switch, and power disconnect switch.

.13 Provide drives suitable for 120 V/1 phase/60 Hz power supply.

.14 Provide drives suitable for local fixed speed or remote variable speed control, from remote 4-20 mA DC input signals.

.15 Provide a floor-mounted support frame for the skid assembly. Fabricate support frame of chemically resistant fibre reinforced plastic (FRP) or chemically resistant black PVC. Provide sufficient strength to allow the support frame to carry the full weight of all of the skid components when full of chemical.

.9 Piping and Valves

.1 Provide Schedule 80 PVC piping and flanges in accordance with Sections 40 00 50, 40 00 51 and 40 00 55. Provide flanges on the inlet and outlets to the skid.

.2 Provide valves and appurtenances of material suitable for the specified chemicals, in accordance with Sections 40 01 00, and 40 01 25.

.3 Provide instrumentation and flow meters in accordance with the document LST-E-002.

.4 Isolation valves to be ball valves. Refer to Section 40 01 00, BV06 for details.

.5 Check valves to be PVC ball check valves with Viton seats, rated for 150 psi.

.6 Valves to be Chemline, Hayward “True Check”, or equivalent.

.7 Pressure relief valves to be PVC with Viton seals, with no external metal fasteners and have corrosion resistant coated internal spring to cover the valve’s entire set pressure range. Valves to be hand adjustable without tools. Valve to relieve pressure in the range 5 to 75 psi. Valves to be Chemline, Hayward, or equivalent.

.8 Back-pressure regulating valves to have Viton seals. Provide Chemline SB12 or equivalent.

.10 Painting

.1 Shop prime and paint equipment in accordance with Section 09 91 12.

.2 All metal surface including frames shall be coated with chemical-resistant coating.

.11 Spare Parts and Maintenance Materials

.1 Provide one complete spare pump including motor for use as a shelf standby.

.2 Provide the following spare parts:

.1 Two (2) service sets (including bearings (if required) and O– rings).

.2 Two (2) backpressure valve diaphragms.

.3 Two (2) pressure relief valve diaphragms.

.4 Two (2) strainers

.3 Provide a list of spare parts which would be expected to be required over a period of five years under normal conditions. At the Contract Administrator's request, provide a price for the listed parts.

2.5 SODIUM HYDROXIDE METERING PUMPS

.1 Description

.1 Equipment to be capable of pumping ferric chloride.

.2 The system includes metering pumps, strainers, controls, calibration column, backpressure valves, pressure relief valves, ball valves, pressure gauges, high pressure switches, check valves, magnetic flow meters, and all associated piping and fittings, in accordance with the Drawings.

.3 The whole system shall take into account the specific gravity, viscosity, corrosivity and temperature of the fluid being pumped.

.2 Tag Numbers

.1 P-F0830

.2 P-F0831

.3 P-F0832

.3 Design Standard

.1 Pulsafeeder (Eclipse)

.4 Acceptable Manufacturers

.1 Pulsafeeder Engineering Products or approved equal as per B8.

.5 Capacities and Performance

.1 Sodium Hydroxide: 50%.

.2 Design pumps to handle abrasive crystals that may form in the solution.

.3 Fluid temperature: 5°C to 35°C

.4 Diaphragm Pumps

.1 Number of pumps: 3

.2 Minimum capacity, each: 8 L/hr.

.3 Maximum capacity, each: 400 L/hr.

.4 Maximum backpressure: 400 kPa

.5 Maximum positive suction pressure: 65 kPa (chemical storage tank full).

.6 Maximum negative suction pressure: 50 kPa (chemical storage tank empty).

.7 Maximum differential pressure: 450 kPa

.6 Materials

.1 Fabricate pumps of titanium

.2 Fabricate pipes and valves of PVC

.3 Fabricate skid of fibre reinforced plastic (FRP) or black PVC

.7 Strainers

.1 Provide an inline suction strainer for each metering pump. Use material appropriate for the chemicals being pumped.

.2 Provide flanged Y-type strainers complete with removable plastic 1.5 mm screen and Teflon seals.

.8 Calibration Chamber

.1 Provide 4000 mL calibration cylinder suitable for the chemicals with scale in mL on the side and ball isolation valve for connection to the suction line of each metering pump. Provide column of clear PVC or a translucent material suitable for the chemical application. Do not provide glass cylinders.

.9 Gear Pumps

.1 Provide positive displacement seal-less magnetically driven external gear type metering pumps designed to meet the specified flow ranges when pumping the specified materials. Pumping rate change shall be accomplished by varying the pump operating speed.

.2 Include hydraulic relief valves to protect pumps against overpressure. Set valves according to Manufacturer's recommendations. Fabricate of materials resistant to corrosive chemicals used.

.3 Provide high pressure switches on the discharge of each pump.

.4 The pumps shall provide a constant flow rate for a particular drive speed and provide linear pulsation-free output flow at all chemical liquid level in storage tanks.

.5 The driven magnet shall be an encapsulated assembly mounted on the end of the pump shaft. The drive magnet assembly shall rotate around the containment can as a result of the magnetic force.

.6 The pumps shall have a pumping accuracy of +5 percent of the full range.

.7 Combined pump, motor and variable frequency controller system shall be capable of providing a 100:1 turndown ratio.

.8 Construct the pump parts in contact with the chemical being pumped from materials suitable for the chemical application. Construct the pump of the following materials:

.1 Pumps: hardened titanium construction

.2 Wear plates: ceramic

.3 Shafts: ceramic

.4 Gears: Teflon or Ryton

.9 Provide pressure relief valve and backpressure regulating valve for each pump discharge, sized for the maximum pump flow with an adjustable pressure range. Valve material to be compatible with the chemical being pumped.

.10 Provide pumps suitable for connection to variable speed drive.

.11 Provide motors suitable for variable speed operation refer to Section 26 29 23. Motors shall include position feedback encoder for closed loop speed control, compatible with supplied variable frequency drive.

.12 Motors to be designated IEEE Chemical Industry - Severe Duty TEFC (CISD-TEFC).

.13 Provide local control for each pump, complete with speed indicator, manual speed control, computer-off-hand, selector, lock-off-stop pushbutton, start/stop switch, and power disconnect switch.

.14 Provide variable speed drives, in accordance with Section 26 29 23, capable of producing the required torque and power to operate the pumps over the entire speed range required to match specified dose rates.

.15 Provide drives suitable for 208 V/3 phase/60 Hz power supply.

.16 Provide drives suitable for local fixed speed or remote variable speed control, from remote 4-20 mA DC input signals.

.17 Provide a floor-mounted support frame for the skid assembly. Fabricate support frame of chemically resistant fibre reinforced plastic (FRP) or chemically resistant black PVC. Provide sufficient strength to allow the support frame to carry the full weight of all of the skid components when full of chemical.

.10 Piping and Valves

.1 Provide Schedule 80 PVC piping and flanges in accordance with Sections 40 00 50, 40 00 51 and 40 00 55. Provide flanges on the inlet and outlets to the skid.

.2 Provide valves and appurtenances of material suitable for the specified chemicals, in accordance with Sections 40 01 00, and 40 01 25.

.3 Provide instrumentation and flow meters in accordance with the document LST-E-002.

.4 Isolation valves to be ball valves. Refer to Section 40 01 00, BV06 for details.

.5 Check valves to be PVC ball check valves with Viton seats, rated for 150 psi.

.6 Valves to be Chemline, Hayward “True Check”, or equivalent.

.7 Pressure relief valves to be PVC with Viton seals, with no external metal fasteners and have corrosion resistant coated internal spring to cover the valve’s entire set pressure range. Valves to be hand adjustable without tools. Valve to relieve pressure in the range 5 to 75 psi. Valves to be Chemline, Hayward, or equivalent.

.8 Back-pressure regulating valves to have Viton seals. Provide Chemline SB12 or equivalent.

.11 Control Panel

.1 Provide remotely-mounted variable frequency drive control panels and remotely-mounted control stations for the pump skid. The panels and control stations are to include pump speed controls and all features necessary for the system to operate as described and to permit the system to operate on remote automatic control or on local or remote manual control.

.2 Each control panel to include the following:

.1 Variable frequency drives, transformer, relays, line reactors, fused disconnect, wireway-lamacoid nameplates, etc.

.2 Each panel to be suitable for 208 V, 3 phase, 60 Hz power supply.

.3 Factory finished NEMA 4X, 316 stainless steel enclosures to house all required components. Provide enclosure with a hinged, lockable front face. Provide accessories to mount the panel at a suitable operating height. Mount all indicators, hand switches, contacts, etc, on the panel face.

.4 Provide the following for each pump:

.1 One Computer-Off-Hand switch

.2 One Lock-Off-Stop switch

.3 One Speed Controller (key pad)

.4 One Alarm Reset push-button

.5 One RED-ON/GREEN-OFF light.

.5 Provide voltage free form C contacts for all digital points and optically isolated connections for all analogue points in accordance with the Drawings.

.6 Terminate all connections to external wiring inside the panel at 208 V terminal strip for connection to wiring by Division 26.

.12 Control Description

.1 When required, the gear pump system is turned on manually. The pumps are switched on through a power disconnect switch in the local panel. Each injection point has a dedicated metering pump system.

.2 Automatic control sets the chemical dose in response to a 4-20 mA signal, which is used to vary the pump drive speed.

.3 The three lines from the metering pumps cross connect to discharge to injection points.

.13 Painting

.1 Shop prime and paint equipment in accordance with Section 09 91 12.

.2 All metal surface including frames shall be coated with chemical-resistant coating.

.14 Spare Parts and Maintenance Materials

.1 Provide one complete spare pump including motor for use as a shelf standby.

.2 Provide the following spare parts:

.1 Three (3) service sets (including gears, shoes, bearings (if required) and O– rings).

.2 Three (3) sets of ceramic wear parts.

.3 Three (3) backpressure valve diaphragms.

.4 Three (3) pressure relief valve diaphragms.

.5 Three (3) strainers

.3 Provide a list of spare parts which would be expected to be required over a period of five years under normal conditions. At the Contract Administrator’s request, provide a price for the listed parts.

Part 3 Execution

3.1 EXAMINATION

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

3.2 MANUFACTURER'S REPRESENTATIVE

.1 To ensure the equipment is installed, operated, and maintained in accordance with the manufacturer's recommended procedures, arrange for a technically qualified Manufacturer's Representative to witness the installation work, certify correct installation, train operating and maintenance staff, and undertake system testing.

3.3 TESTING

.1 Ensure the equipment, including all component parts, operates as intended.

3.4 SYSTEM CLEANING

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

3.5 COMMISSIONING

.1 Attend during commissioning of the process system which includes the equipment specified in this section and to ensure the equipment functions as intended in the process system.

3.6 CLEANING

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

.1 Leave Work area clean at end of each day.

3.7 PROTECTION

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 01 33 00 - Submittal Procedures

.2 01 78 00 - Closeout Submittals

.3 Section 40 00 05 – General Process Provisions

.4 Tank General Arrangement Drawings

.1 1-0101-MGAD-F031-001
.2 1-0101-MGAD-F032-001
.3 1-0101-MGAD-F033-001
.4 1-0101-MGAD-F034-001

1.2 REFERENCE STANDARDS

.1 Conform to the following reference standards:

.1 CAN/CGSB-41.22 Fiberglass-Reinforced Plastic Corrosion-Resistant Equipment
.2 ANSI B16.5 Pipe Flanges and Flanged Fittings
.3 ASTM C581 Standard Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass-Fiber-Reinforced Structures Intended for Liquid Service
.4 ASTM C582 Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion Resistant Equipment
.5 ASTM D2563 Standard Practice for Classifying Visual Defects in Glass-Reinforced Plastic Laminate Parts
.6 ASTM D2583 Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
.7 ASTM D2584 Standard Test Method for Ignition Loss of Cured Reinforced Resins
.8 ASTM D3299 Standard Specification for Filament Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks
.9 ASTM D4097 Standard Specification for Contact-Molded Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks
.10 ASTM E1067 Standard Practice for Acoustic Emission Testing of Fiberglass Reinforced Plastic Resin (FRP) Tanks/Vessels

1.3 DESIGN REQUIREMENTS

.1 Design tank, including resin selection, wall thickness, methods and locations of support, and stiffener requirements. Design shall be signed and sealed by a Professional Engineer registered in the Province of Manitoba.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

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

.3 Shop Drawings:

.1 Indicate on drawings:

.1 Mounting arrangements.

.2 Operating and maintenance clearances.

.2 Shop drawings and product data accompanied by:

.1 Complete design calculations for tanks, supports and accessories.

.2 Detailed description of the laminate and the type of reinforcing to be used indicating:

.1 The laminate and reinforcing material used will provide chemical resistance at least equal to the published chemical resistance for the resin for the intended application.

.2 The resin will meet the performance requirements stated and is suitable for the service conditions specified herein and the fabrication technique proposed.

.3 Laminate sample representative of production quality of surface finish and visual imperfections.

.4 Certified test results on physical property, chemical resistance, and quality control test data.

.5 Evidence of installer's qualifications and experience for similar installations; and results of factory testing prior to commencement of work.

.6 Detailed drawings of bases, supports, and anchor bolts.

.7 Detailed fabrication drawings showing connections and termination of equipment for connection by others.

.8 Installation instructions indicating mounting requirements, alignment and assembly tolerances and points of connection for ancillary services.

.9 List of materials of construction, detailing the component parts and reference specifications (ASTM, CSA, ANSI, etc.) Include complete resin system information.

.10 Tank data indicating equipment number, pressure rating, diameter, straight shell lengths, overall lengths, wall thickness, corrosion barrier thickness, and details of nozzle designs.

.11 Tank capacity chart indicating liters for each 10 cm of depth and cumulative total from bottom.

.12 Fabricator's detailed requirements for tank foundations.

.13 Recommended bolt torque for all bolted FRP connections.

.14 Manufacturer to certify current model production.

.15 Section drawing indicating connections

.16 Drawing dimensions

.3 Quality Control Submittals

.1 Provide the following information for quality control:

.1 Manufacturer's Certificate of Compliance with fabrication requirements.

.2 Qualifications of Acoustic Emission Testing Agency.

.3 Qualifications of Manufacturer 's Quality Assurance Supervisor.

.4 Copy of the Manufacturer 's Quality Assurance Program.

.5 Quality Assurance Inspection:

.6 Qualifications of Independent FRP Quality Assurance Inspector.

.1 Initial QA Inspection Report.

.2 Certification of Factory Testing.

.7 Certification that the access nozzles have been coordinated with the actual equipment being furnished.

.8 Special shipping, storage and protection, and handling instructions.

.9 Manufacturer 's written installation and tank support instructions.

.10 Acoustic emissions test results showing that tank conforms with ASTM E1067.

.2 Quality Assurance

.1 Fabricator's Quality Assurance Supervisor: minimum of 5 years of experience in the fabrication of fiberglass structures.

.2 Designer: Professional Engineer registered in the Province of Manitoba.

.3 Independent FRP Quality Assurance Inspector:

.1 Minimum 5 years of experience as an FRP inspector.

.2 Representing a corporately and financially independent organization which can function as an unbiased inspection authority.

.3 Professionally independent of manufacturer's, suppliers, and installers of systems being inspected.

.4 Acoustic Emission Testing Agency: Minimum 5 years of experience in acoustic emission testing of fiberglass structures.

1.5 CLOSEOUT SUBMITTALS

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

.1 Detailed fabrication drawings indicating equipment number, pressure rating, diameter, straight shell lengths, overall lengths, wall thickness, corrosion barrier thickness, and details of nozzle designs.

.2 Installation instructions indicating mounting requirements, alignment and assembly tolerances and points of connection for ancillary services.

.3 Fabricators catalog information, descriptive literature, specifications, and identification of materials of construction. Include complete resin system information.

1.6 DELIVERY, STORAGE AND HANDLING

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

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

.3 Mount tanks on padded cradles if shipped horizontally or on a suitable skid if shipped vertically.

.4 Protect all flanged nozzles with wooden blinds bolted to the flange and having a diameter of 50 mm greater than the outside diameter of the flange.

.5 Provide either rigid plugs inside the ends to prevent deflection or wooden boxes for all unflanged components. Brace the open ends of tanks with a suitable stiffening member to prevent deflection.

.6 Do not ship components or other pieces loose inside the tanks.

.7 Load tanks with at least 50 mm clearance between the tank (including fittings) and the bulkheads or bed of the vehicle.

.8 Regardless of the mode of transportation, firmly fasten and pad all components to prevent shifting of the load or flexing of components while in transit.

Part 2 Products

2.1 FUNCTION

.1 Provide FRP tanks for above ground vertical installation to contain ferric chloride chemical at atmospheric pressure.

.2 Provide carbon steel tanks for above ground vertical installation to contain sodium hydroxide chemical at atmospheric pressure.

.3 Provide polyethylene dosing day tanks for above ground vertical installation to contain ferric chloride chemical at atmospheric pressure.

.4 Supply products modified as necessary by the manufacturer to provide the specified features and to meet the specified operating conditions.

2.2 FRP TANKS (TK-F0730 AND TK-F0740)

.1 Design Standard

.1 Structural Composites Technology Ltd

.2 Acceptable Manufacturers

.1 Structural Composites Technology Ltd
.2 Polywest
.3 Or in accordance with B8.

.3 Design Parameters (Refer to tank data sheets)

.1 Design tanks suitable for the storage of:
.1 Ferric chloride: 37 to 42%, Specific Gravity of 1.39 to 1.46

.2 Design the tanks to the following criteria:
.1 Number of tanks: 2
.2 Minimum working volume, each: 164,000 L

.3 Internal diameter: 5,486.4 mm

.4 Overall height: 6,920 mm

.5 Bottom slope: 0.3 degrees to drain

.6 Design maximum liquid specific gravity: 1.6

.7 Fluid temperature of 5 to 35°C.

.8 Lifting lugs, each: 4

.9 Sight glass with protective FRP cage, each: 1

.3 Provide the following heavy-duty FRP bulkhead connections, located as shown on the Drawings. Final location and quantity of connections to be confirmed during the shop drawing review.

.4 Provide FRP drain pipes and flanges for complete tank drainage, 50 mm diameter. Drain pipe centreline shall not be higher than the lowest point on the tank bottom.

.5 Provide 6 mm thick neoprene blanket pad for each tank suitable for tank bottom.

.4 Fabrication

.1 Fabricate tanks as spiral wound, hand layered or contact molded conforming to the following appropriate ASTM specifications:

.1 Filament wound tanks: design and fabricate in accordance with ASTM D-3299.

.2 Contact moulded tanks: design and fabricate in accordance with ASTM D-4097.

.5 Resin

.1 Selected by Manufacturer, suitable for intended service and subject to approval by the Contract Administrator.

.2 Premium grade and corrosion resistant, such as chlorendic polyester, vinyl ester, or bisphenol A fumarate polyester that has either been evaluated in a laminate by test in

.3 accordance with ASTM C-581 or that has been determined by previous documented service to be acceptable for the service conditions

.4 Use same resin throughout the entire tank shell.

.5 No dyes, pigments, or colorants except in the exterior gel coat.

.6 No fillers or thixotropic agents contained in the resin.

.7 Curing system

.1 As recommended by resin manufacturer or as specified herein.

.2 Apply color coat after inspection of the laminate has been completed. Exterior color to be Manufacturer’s standard, unless specifically requested otherwise by the Contract Administrator.

.3 Cure all products as specified in ASTM D3299 or ASTM D4097.

.4 Measure Barcol hardness according to ASTM D2583.

.8 Post-cure the tank and appurtenances in accordance with resin manufacturer's recommendation for time and temperature. Complete post-curing with warm-to-hot dry air, free of combustion products. Avoid hot spots.

.9 For hypochlorite service, MEKP cobalt catalyst system is allowed in the liner. Cure liner with benzoyl peroxide-dimethyl aniline throughout. The structural layer may be cured with either catalyst system.

.10 Complete any internal repairs or rework prior to post-curing. If repairs are made following post-cure, an additional post-cure cycle is required.

.6 Reinforcement

.1 Chemical surfacing mat constructed from commercial grade E-type glass strands bonded together using a binder. Treat strands with a sizing that is chemically compatible with the lay-up resin used.

.7 Laminate

.1 For the laminate comprising the structural tank (bottom, cylindrical shell, top head) use a corrosion-resistant barrier comprised of an inner surface (corrosion barrier), interior layer, and exterior layer (structural layer).

.2 Meet requirements of the mechanical properties and visual acceptance criteria in ASTM C582 for contact-molded laminates or ASTM D2563 for others to Level II for interior surfaces and Level III for exterior surfaces.

.3 Reinforce inner surface with a resin-rich surfacing veil.

.8 Identification

.1 Identify each tank with Manufacturer's name, capacity in litres, maximum temperature, design pressure and vacuum, specific gravity, pH, resin, minimum thickness, tank number, tank name, and date of manufacture.

.2 Provide permanent marking decals and labels, sealed into the laminate exterior with clear resin.

.9 Nozzles

.1 Provide all flanged nozzles with the pipe stub moulded integrally with the pipe flange. Compression-moulded or cemented-on flanges are prohibited.

.2 Nozzles 100 mm diameter and smaller shall be be gusseted with conical- or plate-type gussets. Plate gussets to be suitably connected to the flange back side, hub, pipe neck, and tank wall. Nozzles larger then 100 mm in diameter to be gusseted only where noted.

.3 Provide nozzles with a 150 mm projection as measured from the face of the flange to the inside wall of the tank.

.4 Shell nozzles to be mounted radially, perpendicular to the side shell. Top nozzles to be mounted parallel to the vertical axis of the tank.

.5 Finish nozzles flush with the inside surface of the tank unless otherwise indicated.

.6 The back face of all flanges to be spot-faced, flat and parallel to the flange face of sufficient diameter to accept an SAE metal washer under the bolthead or nut.

.7 Tank manway to be Manufacturer’s standard vapour-tight flanged and bolted.

.8 Gaskets

.1 Provide two gaskets per nozzle, 3 mm thick full-face elastomeric material having a hardness of Shore A60 plus or minus 5.

.2 Gasket material to be suitable for the intended service.

.3 All flanged nozzles shall be rated at 1000 kPa minimum with outer dimensions and drilling corresponding to ANSI B16.5.

.4 Provide nozzles and manways as listed at locations shown on the Contract Drawings.

.10 Ancillary components

.1 Pipe Supports

.1 Provide for all tank overflow pipes, loading pipes and recirculation pipes.

.2 Spacing of supports to be as recommended by the fabricator, but not greater than 1200 mm on center.

.3 Design support to allow removal of the pipe.

.4 Provide supports of titanium steel complete with necessary bolts, nuts and washers.

.2 Provide suitably attached lifting lugs for all tanks weighing over 45 kg.

.1 Provide anchor connections and anchor bolts of titanium steel suitably sized by the manufacturer.

.11 Quality Control and Factory Tests

.1 Provide services of an Independent FRP Testing Inspector to be present at the point of manufacture at the time fabrication is started, to perform the following:

.1 Observe manufacturing methods, machinery, and techniques to assure compliance with industry standards and these specifications.

.2 Observe initial fabrication to verify compliance with these specifications.

.3 Observe quality control methods for mixing resins and testing of completed equipment.

.4 Generally, observe quality of other, ongoing fabrication.

.5 Prepare an Initial QA Inspection Report.

.2 Provide services of an Independent FRP Testing Inspector to be present at the point of manufacture, upon completion of fabrication and prior to shipment, to perform or witness the following:

.1 Visual inspection of all FRP tanks supplied to the requirements of ASTM C-582 and ASTM D-2563.

.2 Barcol Hardness measurements per ASTM D2583.

.3 Acetone sensitivity test for all internal secondary bonds.

.4 Glass content by ignition loss on three cutouts per ASTM D2584.

.5 Hydrostatic leak test

.1 Perform on each tank.

.2 Fill to overflow nozzle and allow to stand for 24 hours with no visible leakage.

.6 Repairs deemed acceptable by the Independent FRP Testing Inspector must be approved by the Contract Administrator.

.7 Identify and retain all cutouts. The Contract Administrator may select certain cutouts for testing for physical properties of the laminate.

.8 Factory test reports: certify the results, by signature, of the following:

.1 Inspections

.2 Results of hydrostatic testing

.3 Test reports of physical properties of standard laminates

2.3 CARBON STEEL TANKS (TK-F0810 AND TK-F0820)

.1 Design Standard

.1 Steel Craft

.2 Acceptable Manufacturers

.1 Steel Craft
.2 Parr Metal
.3 Novid
.4 Or in accordance with B8.

.3 Design Parameters (Refer to tank data sheets)

.1 Design tanks suitable for the storage of:
.1 50% Sodium Hydroxide at Specific Gravity of 1.5
.2 Design the tanks to the following criteria:
.1 Number of tanks: 2
.2 Total volume, each: 46,000 L
.3 Minimum working volume, each: 35,000 L
.4 Internal diameter: 3,660 mm
.5 Overall height: 4,330 mm
.6 Design maximum liquid specific gravity:
.7 Fluid temperature of 5 to 35°C.
.8 Lifting lugs, each: 4
.3 Provide the following bulkhead connections, located as shown on the Drawings. Final location and quantity of connections to be confirmed during the shop drawing review.
.4 Provide drain pipes and flanges for complete tank drainage, 50 mm diameter. Drain pipe centreline shall not be higher than the lowest point on the tank bottom.
.5 Provide 6 mm thick neoprene blanket pad for each tank suitable for tank bottom.

.4 Identification

.1 Identify each tank with Manufacturer's name, capacity in litres, maximum temperature, design pressure and vacuum, specific gravity, pH, minimum thickness, tank number, tank name, and date of manufacture.
.2 Provide permanent marking decals and labels.

.5 Nozzles

.1 Provide all flanged nozzles with the pipe stub moulded integrally with the pipe flange. Compression-moulded or cemented-on flanges are prohibited.
.2 Nozzles 100 mm diameter and smaller shall be gusseted with conical- or plate-type gussets. Plate gussets to be connected to the flange back side, hub, pipe neck, and tank wall. Nozzles larger then 100 mm in diameter to be gusseted only where noted.
.3 Provide nozzles with a 150 mm projection as measured from the face of the flange to the inside wall of the tank.
.4 Shell nozzles to be mounted radially, perpendicular to the side shell. Top nozzles to be mounted parallel to the vertical axis of the tank.
.5 Finish nozzles flush with the inside surface of the tank unless otherwise indicated.
.6 The back face of all flanges to be spot-faced, flat and parallel to the flange face of sufficient diameter to accept an SAE metal washer under the bolthead or nut.
.7 Tank manway to be Manufacturer’s standard vapour-tight flanged and bolted.
.8 Gaskets

.1 Provide two gaskets per nozzle, 3 mm thick full-face elastomeric material having a hardness of Shore A60 plus or minus 5.

.2 Gasket material to be suitable for the intended service.

.3 All flanged nozzles shall be rated at 1000 kPa minimum with outer dimensions and drilling corresponding to ANSI B16.5.

.4 Provide nozzles and manways as listed at locations shown on the Contract Drawings.

.6 Ancillary components

.1 Pipe Supports

.1 Provide for all tank overflow pipes, loading pipes and recirculation pipes.

.2 Spacing of supports to be as recommended by the fabricator, but not greater than 1200 mm on center.

.3 Design support to allow removal of the pipe.

.4 Provide supports of Type 316 stainless steel complete with necessary bolts, nuts and washers.

.2 Provide suitably attached lifting lugs for all tanks weighing over 45 kg.

.1 Provide anchor connections and anchor bolts of Type 316 stainless steel suitably sized by the manufacturer.

.7 Quality Control and Factory Tests

.1 Provide services of an Independent Inspector to be present at the point of manufacture at the time fabrication is started, to perform the following:

.1 Observe manufacturing methods, machinery, and techniques to assure compliance with industry standards and these specifications.

.2 Observe initial fabrication to verify compliance with these specifications.

.3 Observe quality control methods for mixing resins and testing of completed equipment.

.4 Generally, observe quality of other, ongoing fabrication.

.5 Prepare an Initial QA Inspection Report.

.2 Provide services of an Independent Inspector to be present at the point of manufacture, upon completion of fabrication and prior to shipment, to perform or witness the following:

.1 Perform on each tank.

.2 Fill to overflow nozzle and allow to stand for 24 hours with no visible leakage.

.2 Repairs deemed acceptable by the Inspector must be approved by the Contract Administrator.

.3 Identify and retain all cutouts. The Contract Administrator may select certain cutouts for testing for physical properties of the laminate.

.4 Factory test reports: certify the results, by signature, of the following:

.1 Inspections

.2 Results of hydrostatic testing

2.4 POLYETHYLENE TANKS (TK-G0750 AND TK-Y0790)

.1 Design Standard

.1 PolyWest

.2 Acceptable Manufacturers

.1 Snyder

.3 Design Parameters

.1 Design tanks suitable for the storage of:

.1 Ferric chloride: 37 to 42%, Specific Gravity of 1.39 to 1.46

.2 Design the tanks to the following criteria:

.1 Number of tanks: 2

.2 Total volume, each: 600 L

.3 Minimum working volume, each: 500 L

.4 Internal diameter: 863.6 mm

.5 Overall height: 1574.8 mm

.6 Bottom slope: Flat

.7 Design maximum liquid specific gravity:

.8 Fluid temperature of 5 to 35°C.

.9 Lifting lugs, each: 4

.3 Provide the following bulkhead connections, located as shown on the Drawings.

.1 Fill: one 75 mm FF flange

.2 Instrumentation: two 150 mm FF flanges

.3 Vent: one 250 mm FF flange

.4 Outlet: one 50 mm FF flange

.5 Overflow: one 100 mm FF flange

.6 Process vent: one 20 mm FF flange

.7 Viewing hatch: one 300 mm hinged

.4 Provide drain pipes and flanges for complete tank drainage, 50 mm diameter. Drain pipe centreline shall not be higher than the lowest point on the tank bottom.

.5 Provide 6 mm thick neoprene blanket pad for each tank suitable for tank bottom.

.4 Fabrication

.1 To ASTM D-1998

.5 Identification

.1 Identify each tank with Manufacturer's name, capacity in litres, maximum temperature, design pressure and vacuum, specific gravity, pH, minimum thickness, tank number, tank name, and date of manufacture.

.2 Provide permanent marking decals and labels.

.6 Nozzles

.1 Provide all flanged nozzles with the pipe stub moulded integrally with the pipe flange. Compression-moulded or cemented-on flanges are prohibited.

.2 Nozzles 100 mm diameter and smaller shall be be gusseted with conical- or plate-type gussets. Plate gussets to be suitably laminated to the flange back side, hub, pipe neck, and tank wall. Nozzles larger then 100 mm in diameter to be gusseted only where noted.

.3 Provide nozzles with a 150 mm projection as measured from the face of the flange to the inside wall of the tank.

.4 Shell nozzles to be mounted radially, perpendicular to the side shell. Top nozzles to be mounted parallel to the vertical axis of the tank.

.5 Finish nozzles flush with the inside surface of the tank unless otherwise indicated.

.6 The back face of all flanges to be spot-faced, flat and parallel to the flange face of sufficient diameter to accept an SAE metal washer under the bolthead or nut.

.7 Tank manway to be Manufacturer’s standard vapour-tight flanged and bolted.

.8 Gaskets

.1 Provide two gaskets per nozzle, 3 mm thick full-face elastomeric material having a hardness of Shore A60 plus or minus 5.

.2 Gasket material to be suitable for the intended service.

.3 All flanged nozzles shall be rated at 1000 kPa minimum with outer dimensions and drilling corresponding to ANSI B16.5.

.4 Provide nozzles and manways as listed at locations shown on the Contract Drawings.

.7 Ancillary components

.1 Pipe Supports

.1 Provide for all tank overflow pipes, loading pipes and recirculation pipes.

.2 Spacing of supports to be as recommended by the fabricator, but not greater than 1200 mm on center.

.3 Design support to allow removal of the pipe.

.4 Provide supports of Titanium steel complete with necessary bolts, nuts and washers.

.2 Provide suitably attached lifting lugs for all tanks weighing over 45 kg.

.1 Provide anchor connections and anchor bolts of Type 316 stainless steel suitably sized by the manufacturer.

.8 Quality Control and Factory Tests

.1 Provide services of an Independent Inspector to be present at the point of manufacture at the time fabrication is started, to perform the following:

.1 Observe manufacturing methods, machinery, and techniques to assure compliance with industry standards and these specifications.

.2 Observe initial fabrication to verify compliance with these specifications.

.3 Observe quality control methods for mixing resins and testing of completed equipment.

.4 Generally, observe quality of other, ongoing fabrication.

.5 Prepare an Initial QA Inspection Report.

.2 Provide services of an Independent Inspector to be present at the point of manufacture, upon completion of fabrication and prior to shipment, to perform or witness the following:

.1 Perform on each tank.

.2 Fill to overflow nozzle and allow to stand for 24 hours with no visible leakage.

.2 Repairs deemed acceptable by the Inspector must be approved by the Contract Administrator.

.3 Identify and retain all cutouts. The Contract Administrator may select certain cutouts for testing for physical properties of the laminate.

.4 Factory test reports: certify the results, by signature, of the following:

.1 Inspections

.2 Results of hydrostatic testing

Part 3 Execution

3.1 EXAMINATION

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

3.2 MANUFACTURER'S REPRESENTATIVE

.1 Provide the services of a technically qualified Manufacturer's Representative for installation, testing and commissioning.

3.3 INSTALLATION

.1 Ensure the equipment is installed as required to provide satisfactory service.

.2 Have the Manufacturer’s Representative instruct installer in the methods and precautions to be followed in the installation of the equipment.

.3 Accurately place anchor bolts using templates furnished by the fabricator.

.4 Coordinate installation of FRP tanks in designated containment areas with other Divisions.

.5 Have the Manufacturer’s Representative supervise and cooperate with the installer as necessary.

.6 Have the Manufacturer’s Representative verified successful installation?

3.4 TESTING

.1 Ensure the equipment, including all component parts, operates as intended.

.2 Performance Testing

.1 Functional test: conduct hydrostatic leak test on all tanks supplied. Fill tank with clean water and allow water to stand for 24 hours to verify no leakage.

.2 Acoustic emission test

.1 Provide services of an acoustic emission test agency to conduct test on each tank following installation and immediately prior to commissioning.

.2 Test completed tank in accordance with ASTM E1067.

.3 Test results and report for acoustic emission test.

.4 In the event that the test fails acceptance criteria as per ASTM E1067, the equipment will be rejected as not conforming to the performance guarantees. In this event modify or replace the equipment and re-test such that the tank(s) will meet the performance test requirements, at no additional cost.

.3 Cooperate with the installer to fulfill the requirements for successful testing of the equipment.

3.5 SYSTEM CLEANING

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

3.6 COMMISSIONING

.1 Attend during commissioning of the process system which includes the equipment specified in this section and to ensure the equipment functions as intended in the process system.

3.7 CLEANING

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

.1 Leave Work area clean at end of each day.

3.8 PROTECTION

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 01 33 00 - Submittal Procedures

.2 01 78 00 - Closeout Submittals

.3 40 00 05 – General Process Provisions

.4 40 00 10 – Chemical Procurement

.5 40 05 01 – Chemical Storage Tanks

1.2 REFERENCE STANDARDS

.1 Conform to the following reference standards:

.1 CAN/CGSB-41.22 Fiberglass-Reinforced Plastic Corrosion-Resistant Equipment

.2 ASTM C581 Standard Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass-Fiber-Reinforced Structures Intended for Liquid Service

.3 ASTM C582 Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion Resistant Equipment

.4 ASTM D2563 Standard Practice for Classifying Visual Defects in Glass-Reinforced Plastic Laminate Parts

.5 ASTM D2583 Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor

.6 ASTM D2584 Standard Test Method for Ignition Loss of Cured Reinforced Resins

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

.3 Shop Drawings: submit Shop Drawings for approval prior to fabrication with the following minimum details:

.1 Containment dimensions (L x W x H)

.2 Absorbency capacity

.3 Chemical compatibility.

.1 To include confirmed chemical concentrations.

.4 Load Capacity

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 containment pallets.

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 Deliver materials and products in labeled protective packages. Store and handle in strict compliance with manufacturer’s instructions and recommendations. Protect from damage from weather, excessive temperatures and construction operations.

Part 2 Products

2.1 SYSTEM INFORMATION

.1 Chemical containment pallets are to be used as a base for all chemical metering pumps and chemical storage tanks. Minimum capacity for chemical containment pallets shall be 1000 L.

.2 In the event of an accidental spill from the tanks or pumps, the chemical containment pallets should ensure that no chemicals spill or leak to other areas of the facility.

.3 The chemical containment pallets directly underneath chemical tanks should have an absorbency equal or greater to 1.1 times (10% additional capacity) the chemical storage tank capacity.

.1 An additional containment pallet of equal size shall be placed underneath the associated chemical metering pumps.

.4 Individual chemical containment pallets can be used in parallel, or placed adjacent, such that there is no containment gap between the tanks and pumps.

.5 Each containment pallet should be primarily coloured in Safety Yellow (CSA).

.6 Grating should be removeable with minimal tools.

.7 The pallets must be transportable with a forklift.

.8 Overall dimensions of the chemical containment pallet system once fully assembled shall be such that there is a minimum space of 450mm from the edge of the assembled containment pallet to the nearest system located on top of the skid. Refer to Drawings for general dimensions of the containment pallet system.

2.2 MATERIALS

.1 The chemicals that may require containment, ferric chloride and sodium hydroxide, are highly corrosive. All components of containment pallets must be compatible with their associated chemical.

.2 Refer to Chemical Procurement, 40 00 10, for additional information.

.3 The containment portion and grating should be injection moulded for longevity.

2.3 ACCEPTABLE MANUFACTURER

.1 Make: Brady Canada Spill Pallet – 4 Drum

.2 Model: SC-DP4

.3 Other manufacturers may be used as an approved equal as per B8

.1 Pump skid supplier may also supply chemical containment pallets if approved as equal.

Part 3 Execution

3.1 EXAMINATION

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

3.2 MANUFACTURER'S REPRESENTATIVE

.1 Provide the services of a technically qualified Manufacturer's Representative for installation, testing and commissioning.

3.3 INSTALLATION

.1 Install and use per manufacture instructions.

3.4 TESTING

.1 Perform sample chemical compatibility test.

.2 Leak test: fill containment pallet with water to maximum containment capacity. Visually inspect for any leaking.

3.5 SYSTEM CLEANING

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

3.6 COMMISSIONING

.1 Attend during commissioning of the process system which includes the equipment specified in this section and to ensure the equipment functions as intended in the process system.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 01 33 00 - Submittal Procedures

.2 01 78 00 - Closeout Submittals

.3 40 00 05 – General Process Provisions

.4 40 00 10 – Chemical Procurement

.5 40 05 01 – Chemical Storage Tanks

.6 Tank Datasheets

1.2 REFERENCE STANDARDS

.1 Conform to the following reference standards:

.1 CAN/CGSB-41.22 Fiberglass-Reinforced Plastic Corrosion-Resistant Equipment

.2 ASTM C581 Standard Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass-Fiber-Reinforced Structures Intended for Liquid Service

.3 ASTM C582 Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion Resistant Equipment

.4 ASTM D2563 Standard Practice for Classifying Visual Defects in Glass-Reinforced Plastic Laminate Parts

.5 ASTM D2583 Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor

.6 ASTM D2584 Standard Test Method for Ignition Loss of Cured Reinforced Resins

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

.3 Shop Drawings: submit Shop Drawings for approval prior to fabrication with the following minimum details:

.1 Complete bill of materials (B.O.M.)

.2 Overall dimensions (L x W x H)

.3 Details describing key components

.4 Chemical compatibility with ferric chloride.

.1 To include confirmed chemical concentrations.

.4 Installation manual and spare parts list.

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 containment pallets.

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 Deliver materials and products in labeled protective packages. Store and handle in strict compliance with manufacturer’s instructions and recommendations. Protect from damage from weather, excessive temperatures and construction operations.

Part 2 Products

2.1 SYSTEM INFORMATION

.1 Building 101 (ferric chloride railcar shelter) shall have a rail chemical containment system. This system shall drain any accidental drips from railcar chemical unloading into the chemical sump.

.2 The collection system must be capable of collecting fluid from either side of the rail along with the center between both rails.

.3 The collection system shall be sloped such that all fluids drain to a single 100mm PVC drain.

.1 A single “Posi-Pipe” located at the center of the collection system shall connect to this 100mm PVC drain pipe.

.4 The collection track along the rail shall be free-floating and not permanently mounted with hardware or adhesives.

.5 Refer to Drawings for dimensions of the rail chemical containment system.

2.2 ACCEPTABLE SYSTEM

.1 The rail chemical containment system shall be a track collector pan system.

.1 Three (3) fiberglass reinforced plastic (FRP) pans shall be located in-between and outside of the rail track.

.1 Center Pan: One (1) center FRP track to sit in-between the rail track.

.2 Side Pan: Two (2) tracks to sit on the outside of the track.

.2 A grating walkway shall be positioned in the center of the track collector pan system.

.3 Finish to match existing on-site track collector pan system.

.4 Flashing shall be used to create a friction,

.5 All gaps shall be sealed with silicone caulking where possible.

.6 EPDM gasket shall be used for the center Posi-Drain pipe.

2.3 MATERIALS

.1 The following items shall be thermoset fiberglass reinforced plastic (FRP)

.1 Center and side pans

.2 Grating

.3 Flashing

.2 Sealants:

.1 Liquid Seals (Caulking): Silicone

.2 Gaskets: EPDM

2.4 HARDWARE

.1 All fasteners, including nuts and washers, shall be Hastelloy.

.1 Stainless steel (304 or 316 series), zinc plated, or galvanized hardware is not acceptable for use with ferric chloride.

.2 Hardware sizes to follow manufacture installation instructions.

.3 Avoid the use self-tapping screws for installation unless indicated otherwise from manufacturer instructions.

2.5 ACCEPTABLE MANUFACTURER

.1 Approved manufacturer for the rail chemical containment system shall be SynTechnics or approved equal as per B8.

Part 3 Execution

3.1 EXAMINATION

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

3.2 MANUFACTURER'S REPRESENTATIVE

.1 Provide the services of a technically qualified Manufacturer's Representative for installation, testing and commissioning.

3.3 INSTALLATION

.1 Install and use per manufacture instructions.

.2 All cut edges shall be fully de-burred and sealed with a resin coat as per manufacturer instructions.

3.4 TESTING

.1 Perform sample chemical compatibility test.

.2 Leak test: fill the track collection system with water. Visually inspect for any leaking.

3.5 SYSTEM CLEANING

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

3.6 COMMISSIONING

.1 Attend during commissioning of the process system which includes the equipment specified in this section and to ensure the equipment functions as intended in the process system.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and requirements for the identification of new equipment, piping systems, ductwork, valves and controllers, including the installation and location of identification systems.

.2 Related Sections:

.1 01 33 00 - Submittal Procedures
.2 01 74 11 - Cleaning
.3 01 78 00 - Closeout Submittals
.4 Section 40 00 05 – General Process Provisions

1.2 REFERENCES

.1 Canadian Gas Association (CGA)

.1 CSA/CGA B149.1-05, Natural Gas and Propane Installation Code.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
.2 CAN/CGSB-24.3-92, Identification of Piping Systems.

.3 National Fire Protection Association (NFPA)

.1 NFPA 13-2002, Standard for the Installation of Sprinkler Systems.
.2 NFPA 14-2003, Standard for the Installation of Standpipe and Hose Systems.

1.3 SUBMITTALS

.1 Product Data:

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

.3 Product data to include paint colour chips, other products specified in this section.

.4 Samples:

.1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
.2 Samples to include nameplates, labels, tags, lists of proposed legends.

1.4 QUALITY ASSURANCE

.1 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

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

Part 2 Products

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

.1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.

.2 Lettering and numbers raised or recessed.

.3 Information to include, as appropriate:

.1 Equipment: manufacturer's name, model, size, serial number, capacity.

.2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

.1 Colours:

.1 Hazardous: red letters, white background.

.2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).

.2 Construction:

.1 3 mm thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:

.1 Conform to following table:

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

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

.4 Locations:

.1 Terminal cabinets, control panels: use size # 5.

.2 Equipment in Mechanical Rooms: use size # 9.

2.3 EXISTING IDENTIFICATION SYSTEMS

.1 N/A

2.4 EQUIPMENT MANUFACTURER'S NAMEPLATES

.1 Provide metal nameplate on each piece of equipment, mechanically fastened with raised or recessed letters.

.2 Provide Underwriters' Laboratories or CSA registration plates, as required by respective agency.

.3 Manufacturer's nameplates to indicate size, equipment model, manufacturer's name, serial number, voltage, cycle, phase, and power of motors.

2.5 EQUIPMENT - PROJECT IDENTIFICATION NAMEPLATES

.1 Supply and install white lamicoid identification plates, with black lettering, for all equipment installed under this contract. Provide identification plates that are engraved with the unit's 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

575V/3PH/60HZ
CIRCUITS A101, A102, A103

.2 Submit list of plates for review prior to engraving.

2.6 IDENTIFICATION OF PIPING SYSTEMS

.1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.

.2 Pictograms:

.1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.

.3 Legend:

.1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.

.4 Arrows showing direction of flow:

.1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.

.2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.

.3 Use double-headed arrows where flow is reversible.

.5 Extent of background colour marking:

.1 To full circumference of pipe or insulation.

.2 Length to accommodate pictogram, full length of legend and arrows.

.6 Materials for background colour marking, legend, arrows:

.1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.

.2 Other pipes: pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.

.7 For all piping installed under this Contract, use pipe markers designating the pipe service and the direction of flow.

.8 Use pre-printed pipe markers. For pre-printed pipe markers, use self-adhesive, plastic coated cloth labels. In addition to its adhesive, secure each label with a full tape band at each end of the label.

.9 Make direction arrows 150 mm long by 50 mm wide for piping with an outer diameter 75 mm or larger, including insulation. Use 100 mm long by 20 mm wide arrows for smaller diameter piping. Provide double headed arrows where appropriate.

.10 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.

.11 Use stainless steel tags for pipes and tubing with an outer diameter 20 mm and smaller

.12 Colours and Legends:

.1 Where not listed, obtain direction from Contract Administrator.

.2 Colours for legends, arrows: to following table:

Background colour:	**Legend, arrows:**
Yellow	BLACK
White	BLACK

.3 Background colour marking and legends for piping systems:

	Colour	**Colour Code**
Utility Fluids		
Potable Water	Sky Blue	SW 3021
Well Water Supply	Violet	SW 3022
Well Water Return	Violet	SW 3022
Flushing Water	Blue	SW 3023
Hot Water Supply	Green	SW 3024
Hot Water Return	Aqua Green	SW 3025
Glycol Supply	Medium Fuchsia	SW 3026
Glycol Return	Light Fuchsia	SW 3027
Rain Water Leaders	Grey	SW 3028
Process Fluids		
Primary Effluent	Mint Yellow	SW 3030
Primary Sludge	Charcoal Grey	SW 3031
Return Activated Sludge	Orange	SW 3032

Waste Activated Sludge	Yellow	SW 3033
Sludge Mixing System	Pumpkin	SW 3034
Scum/Degreasing	Blue-Grey	SW 3035
Process Drain	White	SW 3036
Mix Age Polymer Tanks	Med. Orange	SW 3040
Polymer Feed Tanks	Teal Blue	SW 3041
Dry Polymer Storage	Light Green	SW 3042
Liquid Polymer Storage	Medium Green	SW 3043
Sludge Feed/Transfer	Dark Yellow	SW 3044
Sludge Cake Line	Medium Yellow	SW 3045
Thin Sludge	Light Yellow	SW 3046
Centrate	Very Light Yellow	SW 3047
Sludge Cake Storage	Medium Yellow	SW 3045
Sludge (Trucked)	Rich Tan	SW 3048
Sludge Cake Hopper	White	SW 3049
Sludge Cake Pump Drive	Dark Green	SW 3050
Ferric Chloride	Bright Yellow	SW 3063
Gases		
Instrument Air	Forest Green	SW 3060
Process Air	Terrace Green	SW 3061
Oxygen	Purple	SW 3062
Chlorine	Bright Yellow	SW 3063
Natural Gas	Safety Yellow	SW 3064
Digester Gas	Red	SW 3065

	Colour	**Colour Code**
Equipment and Misc Metals		
Duct Work	Warm Grey	SW 3070
Steel Pipe Supports	Ansi Light Grey	SW 3071
Bollards	Red	SW 3065
Exterior Pedestals/Panels	Lemon Yellow	SW 3071
Handrails (Painted)	Aluminum	B 59S2
Motors	Red	SW 3065
Motor Bases	Carmine Red	SW 3072
Valves and Pumps	Match conduit	
Valve Hand- and Chain-wheels	Red	SW 3065
Other		
Boilers	Heat Resistant Aluminum	B 59S3
Concrete and Blockwork	Platinum Grey	SW 4012
Note: SW codes are Sherwin Williams		

2.7 VALVES, CONTROLLERS

.1 Brass tags with 12 mm stamped identification data filled with black paint.

.2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.8 CONTROLS COMPONENTS IDENTIFICATION

.1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.

.2 Inscriptions to include function and (where appropriate) fail-safe position.

2.9 EQUIPMENT

.1 Identify all equipment with specified tags as indicated on drawings.

2.10 LANGUAGE

.1 Identification in English.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Perform Work in accordance with CAN/CGSB-24.3 except as specified otherwise.

.2 Provide ULC or CSA registration plates as required by respective agency.

3.3 NAMEPLATES

.1 Locations:

.1 In conspicuous location to facilitate easy reading and identification from operating floor.

.2 Standoffs:

.1 Provide for nameplates on hot and/or insulated surfaces.

.3 Protection:

.1 Do not paint, insulate or cover.

3.4 LOCATION OF IDENTIFICATION ON PIPING SYSTEMS

.1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.

.2 Adjacent to each change in direction.

.3 At least once in each small room through which piping or ductwork passes.

.4 On both sides of visual obstruction or where run is difficult to follow.

.5 On both sides of separations such as walls, floors, partitions.

.6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.

.7 At beginning and end points of each run and at each piece of equipment in run.

.8 At point immediately upstream of major and manually operated or automatically controlled valves. Where this is not possible, place identification as close as possible, preferably on upstream side.

.9 Identification easily and accurately readable from usual operating areas and from access points.

.1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.5 VALVES, CONTROLLERS

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

.2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Contract Administrator. Provide one copy (reduced in size if required) in each operating and maintenance manual.

.3 Number valves in each system consecutively.

3.6 CLEANING

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

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 GENERAL

1.1 SCOPE

.1 Process piping insulation

.2 Adhesives, tie wires, tapes

.3 Recovering

1.2 QUALITY ASSURANCE

.1 Install insulation employing skilled workmen 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 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 JOB CONDITIONS

.1 Deliver material to Site in original non-broken factory packaging, labelled 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.

Part 2 PRODUCTS

2.1 GENERAL

.1 .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 smoldering, 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 labelled.

.4 Insulate fittings and valve bodies with preformed removable insulated fittings.

2.2 MATERIALS

.1 Refer to LST-M-003 – Piping Service Specification Index, Insulation column.

.2 Buried piping: Refer to Division 2, if applicable.

.3 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.

.4 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.

.5 Recovery jackets: 0.9 mm smooth aluminum sheet or paintable canvas for all new insulated piping.

2.3 BURIED PIPING

.1 Provide insulation for all buried piping with a soil cover of less than 2500 mm in grassed areas or less than 3000 mm below roads, walkways and access pads in accordance with drawings and section 40 00 50, if applicable.

.2 Provide insulation for all buried process piping systems.

2.4 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 process mechanical 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 joint 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 of 0.5 mm thick 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/m2 minimum.

Part 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 valves must be insulated), 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 300mm 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 Cold piping: seal lap joints with 100 percent 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 Flare out staples may be used to secure jacket laps on hot systems. Staples are to be applied on 100 mm centres.

.10 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		**Pipe Sizes** mm	**Insulation Thickness (fibreglass)** mm	**Insulation Thickness (closed cell)** mm
1	Insulated Process Piping (Applicable to Buried or Outdoor and Above Ground Piping Systems)	15 to 50 Over 50	50 50	50 50

END OF SECTION