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.

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

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

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

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

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

.10 Keep one reviewed copy of each submission on Site.

1.2 SHOP DRAWINGS AND PRODUCT DATA

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

.2 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 seven (7) 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 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:

.1 Subcontractor.

.2 Supplier.

.3 Manufacturer.

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

.5 Details of appropriate portions of Work as applicable:

.1 Fabrication.

.2 Layout, showing dimensions, including identified field dimensions, and clearances.

.3 Setting or erection details.

.4 Capacities.

.5 Performance characteristics.

.6 Standards.

.7 Operating weight.

.8 Wiring diagrams.

.9 Single line and schematic diagrams.

.10 Relationship to adjacent work.

.8 Submit electronic copy of shop drawings for each requirement requested in specification sections and as Contract Administrator may reasonably request.

.9 Submit electronic 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 copies of test reports for requirements requested in specification sections and as requested by Contract Administrator.

.11 Submit electronic copies of manufacturer’s instructions for requirements requested in specification sections and as requested by Contract Administrator.

.1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards, and safety precautions.

.12 Submit electronic copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Contract Administrator. Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.

.13 Submit six (6) hard copies and six (6) electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Contract Administrator.

.14 Delete information not applicable to Project.

.15 Supplement standard information to provide details applicable to Project.

.16 If upon review by Contract Administrator, no errors or omissions are discovered or if only minor corrections are made, electronic 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.

.17 The review of shop drawings by Contract Administrator is for sole purpose of ascertaining conformance with general concept.

.1 This review shall not mean that Contract Administrator approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of construction and Contract Documents.

.2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.

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 SUBMITTALS

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

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

- .1 Structural integrity of elements of project.
- .2 Integrity of weather-exposed or moisture-resistant elements.
- .3 Efficiency, maintenance, or safety of operational elements.
- .4 Visual qualities of sight-exposed elements.
- .5 Work of City or separate contractor.

.3 Include in request:

- .1 Identification of project.
- .2 Location and description of affected Work.
- .3 Statement on necessity for cutting or alteration.
- .4 Description of proposed Work, and products to be used.
- .5 Alternatives to cutting and patching.
- .6 Effect on Work of City or separate contractor.
- .7 Written permission of affected separate contractor.
- .8 Date and time work will be executed.

1.2 PREPARATION

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

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

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

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

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

1.3 EXECUTION

.1 Execute cutting, fitting, and patching to complete Work.

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

.3 Uncover Work to install ill-timed work.

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

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

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

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

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

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

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

.11 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.

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

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling.

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 the Departmental Representative. Do not burn waste materials on Site.

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

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

.5 Provide and use marked separate bins for recycling.

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

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

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

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

.10 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 Departmental Representative. Do not burn waste materials on Site.

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

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

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

.13 Remove dirt and other disfiguration from exterior surfaces.

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

.15 Sweep and wash clean paved areas. Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.

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

.17 Remove snow and ice from access to building.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE REQUIREMENTS

.1 Pre-warranty Meeting:

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

.1 Verify Project requirements.

.2 Review warranty requirements and manufacturer's installation instructions.

.2 Contract Administrator to establish communication procedures for:

.1 Notifying construction warranty defects.

.2 Determine priorities for type of defects.

.3 Determine reasonable response time.

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

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

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Two weeks prior to Substantial Performance of the Work, submit to the Contract Administrator, six final copies of operating and maintenance manuals in English.

.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.

.5 Copy will be returned after final inspection, with Contract Administrator comments.

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

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

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.

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 Contract Administrator and Contractor with name of responsible parties.

.3 Schedule of products and systems, indexed to content of volume.

.2 For each product or system:

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

.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.

1.5 AS -BUILT DOCUMENTS AND SAMPLES

.1 Maintain at site 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 .

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

.3 Record information concurrently with construction progress.

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

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

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

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

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

.4 Field changes of dimension and detail.

.5 Changes made by change orders.

.6 Details not on original Contract Drawings.

.7 References to related shop drawings and modifications.

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

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

.2 Changes made by Addenda and change orders.

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

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

1.7 FINAL SURVEY

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

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

.13 Include test and balancing reports.

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

1.9 MATERIALS AND FINISHES

.1 Building products, applied materials, and finishes: include product data, with catalogue number, size, composition, and colour and texture designations.

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

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

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

1.10 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.

.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.

1.11 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 to satisfaction of Contract Administrator.

1.12 WARRANTIES

.1 Assemble approved information in binder and submit upon acceptance of work. Organize binder as follows:

.1 Separate each warranty 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, 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.

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

.3 Conduct joint 11 month warranty inspection, measured from Date of Total Performance, by Contract Administrator.

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

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

.1 Demonstrate operation and maintenance of equipment and systems to City's personnel two weeks prior to date of Total Performance.

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

1.2 QUALITY CONTROL

.1 When specified in individual Sections require manufacturer to provide authorized representative to demonstrate operation of equipment and systems, instruct City's personnel, and provide written report that demonstration and instructions have been completed.

1.3 SUBMITTALS

.1 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's approval. Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.

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

1.4 CONDITIONS FOR DEMONSTRATIONS

.1 Equipment has been inspected and put into operation.

.2 Testing, adjusting, and balancing have been performed and equipment and systems are fully operational.

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

1.5 PREPARATION

.1 Verify that conditions for demonstration and instructions comply with requirements.

.2 Verify that designated personnel are present.

1.6 DEMONSTRATION AND INSTRUCTIONS

.1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at agreed upon times, at the designated locations.

.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 need for additional data becomes apparent during instructions.

.5 Provide video recording of each training session.

1.7 TIME ALLOCATED FOR INSTRUCTIONS

.1 Ensure amount of time required for instruction of each item of equipment or system as follows:

.1 Heating, Cooling and Ventilation System: four two-hour sessions of instruction for each of the (four) shifts.

.2 Control System: four two-hour sessions of instruction for each of the (four) shifts.

.3 Electrical System: four one-hour sessions of instruction for each of the (four) shifts.

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 The Contract Documents applied to the work of this Section.

1.2 REFERENCES

.1 ASTM A36/A36M-14, Standard Specification for Carbon Structural Steel.

.2 ASTM A193/A193M-16, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature or High Pressure Service and Other Special Purpose Applications.

.3 ASTM A307-14, Standard Specification for Carbon Steel Bolts and Studs, and Threaded Rod 60,000 psi Tensile Strength.

.4 ASTM A325-14, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

.5 ASTM A325M-14, Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Tensile Strength (Metric).

.6 ASTM F3125/F3125M-15a, Standard Specification for High-Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

.7 CAN/CGSB-85.10-99, Protective Coatings for Metals.

.8 Handbook of Steel Construction, 11th Edition (2016).

.9 CISC/CPMA 1-73a, Quick-Drying, One-Coat Paint for Use on Structural Steel.

.10 CISC/CPMA 2-75, Quick-Drying, Primer for use on Structural Steel.

.11 CAN/CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.12 CAN/CSA-G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

.13 CAN/CSA-S16-14, Design of Steel Structures.

.14 CAN/CSA-S136-12, North American Specification for the Design of Cold-Formed Steel Structural Members.

.15 CAN/CSA-S136.1-12, Commentary on North American Specification for the Design of Cold-Formed Steel Structural Members.

.16 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel Structures.

.17 CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding.

.18 CSA W55.3-08, Certification of Companies for Resistance Welding of Steel and Aluminum.

.19 CSA W59-13, Welded Steel Construction (Metal Arc Welding).

.20 MPI-R2012, Architectural Painting Manual.

.21 MPI-R2012, Maintenance Repainting Manual: Interior Repainting.

.22 MPI-R2012, Maintenance Repainting Manual: Exterior Repainting.

.23 The Society for Protective Coatings (SSPC).

1.3 DESIGN REQUIREMENTS

.1 Design components, details and connections in accordance with requirements of CAN/CSA-S16 and CAN/CSA-S136 with CSA-S136.1 to resist forces, moments, shears, and allow for movements indicated on Drawings, and otherwise.

.2 Design shear connections to develop shear capacity of member being connected and show details on shop drawings.

.3 Design moment connections to develop moment capacity of member being connected and show details on shop drawings.

.4 Design all temporary bracings as required for structural stability during construction stages.

.5 Design all bolt connections with a minimum two bolts in a connection.

.6 Submit sketches and design calculations stamped and signed by qualified Professional Engineer licensed in the province where the work is located for non-standard connections.

1.4 SHOP DRAWINGS

.1 Submit shop drawings including fabrication and erection documents and materials list in accordance with Section 01 33 00.

.2 For LEED projects, submit shop drawings with accompanying LEED Requirements and Environmental Procedures.

.3 Erection drawings shall include details and information necessary for assembly and erection purposes, framing plans and grid lines, bearing details, framed openings, accessories, schedule of materials, camber and loading, fasteners and welds, and required temporary bracing.

.4 Additional erection drawings including sequence of erection and type of equipment used in the erection may be required.

.5 Ensure Fabricator drawings showing designed assemblies, components and connections are stamped and signed by the Contract Administrator licensed in the province where the Work is located.

.6 All shop drawings to be reviewed and checked by the Contractor prior to submission to the Contract Administrator.

.7 Review of shop drawing by the Contract Administrator in no way relieves the Contractor responsibility for the accuracy of the shop drawings.

.8 Specify primer to be used for each member and components.

.9 Fabricator is to certify that all connection design and details including erection procedure have been supervised and carried out by the Contract Administrator licensed in the province where the Work is located.

1.5 QUALITY ASSURANCE

.1 If requested, submit two copies of mill test reports two weeks prior to fabrication of structural steel.

.1 Mill test reports to show chemical and physical properties and other details of steel to be incorporated in project.

.2 Provide mill test reports certified by metallurgists qualified to practice in Canada.

.2 If requested, provide structural steel Fabricator's affidavit stating that materials and products used in fabrication conform to applicable material and products standards specified and indicated.

.3 Submit welder's Certificates.

Part 2 Products

2.1 MATERIALS

.1 Structural steel: to CAN/CSA-G40.20/G40.21 (or ASTM A36/A36M) Grade 350W for rolled section and Grade 300W for plates and angles.

.2 Cold-formed structural members: to CAN/CSA-S136.

.3 Anchor bolts: to CAN/CSA-G40.20/G40.21 Grade 300W.

.4 High strength anchor bolts: to ASTM A193/A 93M.

.5 Bolts, nuts and washers: to ASTM A325/A325M.

.6 Welding materials: to CSA W59 and certified by Canadian Welding Bureau.

.7 Primer: to CISC/CPMA1 for interior steel and to CISC/CPMA2 for exterior steel.

.8 Hot dip galvanizing: galvanize steel, for exterior steel and for where indicated, to CAN/CSA-G164, minimum zinc coating of 700 g/m^2.

.9 Shear studs: to CSA W59, Appendix H.

2.2 FABRICATION

.1 For rehabilitation and remediation projects, verify dimensions prior to commencing fabrication.

.2 Fabricate structural steel in accordance with CAN/CSA-S16 and/or CAN/CSA-S136.

.3 Weld to CSA W59.

.4 Joint surfaces to be free from fins and tears.

.5 Install shear studs in accordance with CSA W59.

.6 Continuously seal members by continuous welds where indicated. Grind smooth.

.7 Seal all hollow structural sections with suitable cap plates or by welding all around to adjoining members.

.8 Splice members are not allowed unless noted otherwise or with a written consent of the Contract Administrator. Where spliced, reliable non-destructive inspection such as X-ray is mandatory to ensure the splice workmanship and at the Contractor's expense.

.9 Weld threaded studs to top flanges for attachment of wood nailers.

.10 Clean, prepare surfaces in accordance with SSPC and prime structural steel in accordance with Manitoba Public Insurance (MPI) except where members to be encased in concrete.

Part 3 Execution

3.1 GENERAL

.1 Structural steel work: to CAN/CSA-S16 and/or CAN/CSA-S136.

.2 Welding: in accordance with CSA W59.

.3 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3 for resistance welding of structural components.

3.2 CONNECTION TO EXISTING WORK

.1 Verify dimensions and condition of existing work, report discrepancies and potential problem areas to the Contract Administrator for direction before commencing fabrication.

3.3 MARKING

.1 Mark materials in accordance with CAN/CSA G40.20/G40.21. Do not use die stamping. If steel is to be left in unpainted condition, place marking at locations not visible from exterior after erection.

.2 Match marking: shop mark bearing assemblies and splices for fit and match.

3.4 ERECTION

.1 Erect structural steel, as indicated and in accordance with CAN/CSA-S16 and/or CAN/CSA-S136 and in accordance with approved reviewed erection drawings.

.2 Field cutting or altering structural members: to approval of the Contract Administrator.

.3 Provide all temporary bracings.

.4 Fix and attach all members and bracing by means of field welding.

.5 Continuously seal members by continuous welds where indicated. Grind smooth.

.6 Level, plumb and align all members to CAN/CSA S16.

.7 Clean with mechanical brush and touch up shop primer to bolts, rivets, welds and burned or scratched surfaces at completion of erection.

.8 Galvanize all exterior structural steel components and all noted or specified components to ASTM A123/A123M.

.9 Weld all anchors required to restrain concrete masonry walls.

.10 Correct to acceptance all errors in member fit and erection.

.11 Do not place holes or openings in structural members without the approval the Contract Administrator. Provide reinforcing plates around all openings to maintain design strength where approval is granted.

.12 Frame all openings in steel deck exceeding 400 mm across the flutes.

.13 Provide steel plates, shelf angles, including anchors, required to support steel deck on masonry walls.

3.5 FIELD QUALITY CONTROL

.1 The Contract Administrator will periodically visit the Site.

.2 Field services by the Contract Administrator do not in any way relieve the Contractor's responsibility to carry out work as shown in the Contract documents.

.3 Inspection of materials and workmanship to be carried out by an independent inspection and testing firm certified in accordance with CAN/CSA W178.1 retained and paid for by the Contractor and approved by the Contract Administrator.

.4 An independent inspection shall include:

.1 Visual inspection of all welds and workmanship that are readily accessible.

.2 Random check of structural steel member sizes and steel deck gauge.

.3 Other non-destructive tests, if required.

.4 Review welder's certificates and welding procedure.

.5 Inspect all puddle welds and side lap crimping of accessible steel decking.

.6 Confirm acceptable coatings.

.7 Tracking all noted deficiencies and providing report to all relevant parties.

.8 A final report sealed and signed by the Contract Administrator registered in the province where the Work is located certifying that all welds and connections, including confirmation that required repairs have been completed.

.5 Provide safe access and working areas for testing and inspection on Site, as required by testing agency and/or the Contract Administrator.

.6 Submit mill test reports to Contract Administrator upon request.

.7 The Contractor will pay costs of inspection and testing, re-inspection as a result of defective workmanship, and repairs to correct defective work.

.8 Additional inspection or test may be requested by the Contract Administrator with the approval of the City. The cost associating with approved additional inspections or tests to be paid for by the City.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Unless otherwise noted, refer to the latest references and standards listed herein adopted by the local authority having jurisdiction.

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 the Mechanical Contractors Association of Canada (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 reviewed 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: servicing, maintenance, operation, and trouble-shooting instructions for each item of equipment.
  - .1 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 Reviews:

.1 Submit two copies of draft Operation and Maintenance Manual to Contract Administrator for review. Submission of individual data will not be accepted unless directed by Contract Administrator.

.2 Make changes as required and re-submit as directed by Contract Administrator.

.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 Departmental Representative will provide white prints of the mechanical drawings. 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 white prints, revising white prints 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 review and make corrections as directed.

.4 Perform testing, adjusting and balancing for HVAC using as-built drawings.

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

.10 Submit copies of as-built drawings for inclusion in final TAB report.

Part 2 Products

2.1 NOT USED

.1 Not Used

Part 3 Execution

3.1 DEMOLITION

.1 Preparation

.1 Coordinate utility service outages with utility company and schedule utility to locate exterior services.

.2 Provide temporary connections to maintain existing system in service during construction. When Contractor elects to perform Work on energized equipment, use personnel experienced in such operations.

.3 Beginning of demolition means installer accepts existing conditions.

.2 Demolition

.1 Connect equipment which is existing and is to remain to the new system as required to maintain its proper operation.

.2 Maintain access to existing mechanical installations which remain active. Modify installation or provide access as appropriate.

.3 Scheduling and Phasing

.1 Prior to the start of any demolition work within the building, provide the Contract Administrator a schedule of phased selective demolition for all mechanical demolition at the Site.

.2 Provide the following information for the schedule:

.1 Number of phases of demolition.

.2 Limits of each phase.

.3 Dates of start/finish demolition by phase.

.3 Coordinate the mechanical demolition schedule with all aspects of demolition under other divisions of the specifications.

3.2 PAINTING REPAIRS AND RESTORATION

.1 Repair and paint any affected areas. Paint to match existing colour.

3.3 CLEANING

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

3.4 FIELD QUALITY CONTROL

.1 Site Tests: conduct following tests and submit report as described in Part 1 – Submittals.

.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

3.5 DEMONSTRATION

.1 Departmental Representative, 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.

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 SUMMARY

.1 Section Includes:

.1 Thermal insulation for piping and piping accessories in commercial type applications.

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ASHRAE Standard 90.1, 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, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.

.2 ASTM C335, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.3 ASTM C411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM C449/C449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C533, Calcium Silicate Block and Pipe Thermal Insulation.

.6 ASTM C547, Mineral Fiber Pipe Insulation.

.7 ASTM C795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

.8 ASTM C921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.2 CAN/CGSB-51.53, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts

.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 Manufacturer's Trade Associations

.1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.

.6 The National Energy Code of Canada for Buildings – 2011.

.7 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701, Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.3 CAN/ULC-S702, Thermal Insulation, Mineral Fibre, for Buildings

.4 CAN/ULC-S702.2, 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 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: specialist in performing work of this Section, and have at least three years successful experience in this size and type of project, qualified to standards of TIAC.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturer's written instructions.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

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

.2 Storage and Protection:

.1 Protect from weather, construction traffic.

.2 Protect against damage.

.3 Store at temperatures and conditions required by manufacturer.

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°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] [ASTM C547].

.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] [ASTM C547].

.2 Jacket: to CGSB 51-GP-52Ma.

.3 Maximum "k" factor: to CAN/ULC-S702.

2.3 INSULATION SECUREMENT

.1 Tape: self-adhesive, aluminum, plain, 50 mm wide minimum.

.2 Contact adhesive: quick setting.

.3 Canvas adhesive: washable.

.4 Tie wire: 1.5 mm diameter stainless steel.

.5 Bands: stainless steel, 19 mm wide, 0.5 mm thick.

2.4 CEMENT

.1 Thermal insulating and finishing cement:

.1 Hydraulic setting or air drying on mineral wool, to ASTM C449/C449M.

2.5 VAPOUR RETARDER LAP ADHESIVE

.1 Water based, fire retardant type, compatible with insulation.

2.6 INDOOR VAPOUR RETARDER FINISH

.1 Vinyl emulsion type acrylic, compatible with insulation.

2.7 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 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.

.2 Aluminum:

.1 To ASTM B209.

.2 Thickness: 0.50 mm sheet.

.3 Finish: smooth or stucco embossed.

.4 Joining: longitudinal and circumferential slip joints with 50 mm laps.

.5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.

.6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PRE-INSTALLATION REQUIREMENT

.1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.

.2 Surfaces clean, dry, free from foreign material.

3.3 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturer’s instructions and this specification.

.3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Install hangers, supports outside vapour retarder jacket.

.5 Supports, Hangers:

.1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.4 INSTALLATION OF ELASTOMERIC INSULATION

.1 Insulation to remain dry. Overlaps to manufacturer’s instructions. Ensure tight joints.

.2 Provide vapour retarder as recommended by manufacturer.

3.5 PIPING INSULATION SCHEDULES

.1 Includes flanges and fittings unless otherwise specified.

.2 TIAC Code: A-1.

.1 Securements: SS bands at 300 mm on center.

.2 Seals: lap seal adhesive, lagging adhesive.

.3 Installation: TIAC Code 1501-H.

.3 TIAC Code: A-3.

.1 Securements: SS bands at 300 mm on center.

.2 Seals: VR lap seal adhesive, VR lagging adhesive.

.3 Installation: TIAC Code: 1501-C.

.4 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	**TIAC code**	**Pipe sizes (NPS) and insulation thickness (mm)**				
		Run out	**to 1**	**1 1/4 to 2**	**2 1/2 to 4**	**5 & over**
Hot Water Heating	A-1	25	25	25	38	38
Glycol Heating	A-1	25	25	25	38	38
RWL and RWP	A-3	25	25	38	38	38

.5 Finishes:

.1 Exposed indoors: canvas.

.2 Exposed in mechanical rooms: canvas.

.3 Concealed, indoors: canvas on 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 center. Seals: closed.

.7 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.6 CLEANING

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

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Society for Testing and Materials International, (ASTM):

.1 ASTM D2235, Specification for Solvent Cement for Acrylonitrille-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.

.2 ASTM D2564, Specification for Solvent Cements for Poly (Vinyl-Chloride) (PVC) Plastic Piping Systems.

.2 Canadian Standards Association (CSA International):

.1 CSA-Series B1800, Plastic Non-pressure Pipe Compendium.

.2 CSAB181.1, ABS Drain, Waste, and Vent Pipe and Pipe Fittings.

.3 CSA-B181.2, PVC Drain, Waste and Vent Pipe and Pipe Fittings.

.4 CSA-B182.1, Plastic Drain and Sewer Pipe and Pipe Fittings.

.3 National Research Council (NRC)/Institute for Research in Construction:

.1 NRCC 38728, National Plumbing Code of Canada (NPC) complete with the Manitoba Amendments.

Part 2 Products

2.1 PIPING AND FITTINGS

.1 For buried and/or above ground DWV piping to:

.1 CSA-B181.1.

.2 CSA-B181.2.

.3 CSA-B182.1.

2.2 JOINTS

.1 Solvent weld for PVC: to ASTM D2564.

.2 Solvent weld for ABS: to ASTM D2235.

Part 3 Execution

3.1 INSTALLATION

.1 In accordance with Section 23 05 05 - Installation of Pipework.

.2 Install in accordance with National Plumbing Code and local authority having jurisdiction.

.3 Install in accordance with manufacturer’s recommendations and as specified.

3.2 TESTING

.1 Pressure test buried systems before backfilling.

.2 Hydraulically test to verify grades and freedom from obstructions.

3.3 PERFORMANCE VERIFICATION

.1 Cleanouts:

.1 Ensure accessibility 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 Ensure fixtures are properly anchored, connected to system and effectively vented.

3.4 START-UP

.1 Provide continuous supervision during start-up.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Use of mechanical systems during construction.

1.2 USE OF SYSTEMS

.1 Use of new permanent heat and ventilating systems for supplying temporary heat and ventilation are permitted only under the following conditions:

.1 Entire system is complete, pressure tested, cleaned, flushed out.

.2 Building has been closed in; areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.

.3 There is no possibility of damage.

.4 Supply ventilation systems are protected by approved filters, inspected daily, changed every two weeks or more frequently as required.

.5 Return systems have approved filters over openings, inlets, outlets.

.6 Systems will be:

.1 Operated as per manufacturer's recommendations and instructions;

.2 Operated by Contractor;

.3 Monitored continuously by Contractor.

.7 Warranties and guarantees are not relaxed.

.8 Regular preventive and other manufacturers recommended maintenance routines are performed by Contractor at own expense and under supervision of Contract Administrator.

.9 Refurbish entire system before static completion; clean internally and externally, restore to "as- new" condition, replace filters in air systems.

.2 Exhaust systems are not included in approvals for temporary heating and ventilation.

1.3 NOT USED

.1 Not Used.

Part 2 Execution

2.1 NOT USED

.1 Not Used.

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 Canada Green Building Council (CaGBC)

.1 LEED Canada-NC Version 1.0, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum).

.2 LEED Canada-CI Version 1.0, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.

.3 Canadian Standards Association (CSA International)

.1 CSA B139, Installation Code for Oil Burning Equipment.

.4 Green Seal Environmental Standards (GSES)

.1 Standard GS-11, Environmental Standard for Paints and Coatings.

.5 National Fire Code of Canada

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 Coating: in accordance with manufacturer's recommendations for surface conditions.

.2 Fire Stopping: use approved fire stopping assembly.

Part 3 Execution

3.1 APPLICATION

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

3.2 CONNECTIONS TO EQUIPMENT

.1 In accordance with manufacturer's instructions unless otherwise indicated.

.2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

.3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.3 CLEARANCES

.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer, National Fire Code of Canada and CSA B139.

.2 Provide space for disassembly, removal of equipment and components as without interrupting operation of other system, equipment, and 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 air vents to CSA B139 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.

.6 Use ball valves at branch take-offs for isolating purposes except where specified.

.7 Install ball valves for glycol service.

.8 Use chain operators on valves NPS 2 1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.

.15 Check Valves:

.1 Install silent check valves on discharge of pumps and as indicated.

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

3.8 SLEEVES

.1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and 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 Flush system.

.2 Before start-up, clean interior of piping systems.

.3 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 four hours minimum unless specified for longer period of time in relevant mechanical sections.

.4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.

.5 Conduct tests in presence of 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 at times approved by Contract Administrator.

.2 Request written approval by Contract Administrator, 10 days minimum, prior to commencement of work.

.3 Be responsible for damage to existing plant by this work.

3.14 CLEANING

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

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 22 and 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 Electrical Equipment Manufacturers' Association Council (EEMAC)

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 Quality Control:

.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.

.4 Closeout Submittals

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

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with manufacturers recommendations and Section 01 78 00 Closeout Submittals.

.2 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 electric utility company standards, to ASHRAE 90.1 and MECB 2013.

2.2 MOTORS

.1 Provide motors for mechanical equipment as specified.

.2 Motors under 373 W: speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.

.3 Motors 373 W and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40°C, three-phase, 208V, unless otherwise indicated.

2.3 TEMPORARY MOTORS

.1 If delivery of specified motor will delay completion or commissioning work, install motor reviewed 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: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.

.4 For motors 7.5 kW and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.

.5 Correct size of sheave determined during commissioning.

.6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.

.7 Motor slide rail adjustment plates to allow for centerline adjustment.

.8 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 Site Tests:

.1 Bump motors to insure proper rotation.

.2 Confirm amperage and voltage draws for each leg.

.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 above 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.

3.4 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 Concrete housekeeping pads, hangers and supports for mechanical piping, ducting and equipment.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B31.1, Power Piping.

.2 American Society for Testing and Materials (ASTM) International

.1 ASTM A125, Standard Specification for Steel Springs, Helical, Heat-Treated.

.2 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.3 ASTM A563, Standard Specification for Carbon and Alloy Steel Nuts.

.3 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)

.1 MSS 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.

.4 Underwriter's Laboratories of Canada (ULC)

1.3 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.

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.

.3 Shop Drawings:

.1 Submit shop drawings for:

.1 Bases, hangers and supports.

.2 Connections to equipment and structure.

.3 Structural assemblies.

.4 Certificates:

.1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Manufacturers' Instructions:

.1 Provide manufacturer's installation instructions.

1.5 CLOSEOUT SUBMITTALS

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

Part 2 Products

2.1 GENERAL

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

2.2 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 or epoxy coated.

.2 Upper attachment structural: suspension from lower flange of I-Beam:

.1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.

.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.

.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 to MSS SP69.

.5 Shop and field-fabricated assemblies:

.1 Trapeze hanger assemblies: fabricated from material complying to ASTM A-36.

.6 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.

.7 Pipe attachments: material to MSS SP58:

.1 Attachments for steel piping: carbon steel galvanized.

.2 Attachments for copper piping: copper plated black steel.

.3 Use insulation shields for hot pipework.

.4 Oversize pipe hangers and supports.

.8 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.

.9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.

.10 U-bolts: carbon steel to MSS SP69 with two (2) nuts at each end to ASTM A563.

.1 Finishes for steel pipework: galvanized.

.2 Finishes for copper, glass, brass or aluminum pipework: galvanized, with formed portion plastic coated.

.11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

2.3 RISER CLAMPS

.1 Steel or cast iron pipe: galvanized 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.

2.4 INSULATION PROTECTION SHIELDS

.1 Insulated cold piping:

.1 64 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 12 and over, carbon steel to comply with MSS SP69.

2.5 EQUIPMENT SUPPORTS

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings. Submit calculations with shop drawings.

2.6 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

2.7 HOUSE-KEEPING PADS

.1 Provide 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 50 mm larger than equipment; chamfer pad edges.

.2 Concrete: to Section 03 30 00 - Cast-in-Place Concrete.

2.8 OTHER EQUIPMENT SUPPORTS

.1 Fabricate equipment supports from structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings.

.2 Submit structural calculations with shop 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:

.1 Manufacturer's instructions and recommendations.

.2 Vibration Control Devices:

.1 Install on piping systems at pumps and as indicated.

.3 Clamps on riser piping:

.1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.

.2 Bolt-tightening torques to industry standards.

.3 Steel pipes: install below coupling or shear lugs welded to pipe.

.4 Cast iron pipes: install below joint.

.4 Clevis plates:

.1 Attach to concrete with four (4) minimum concrete inserts, one 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 Provincial Code and authority having jurisdiction.

.2 Fire protection: to applicable fire code.

.3 Gas piping: up to NPS 1/2: every 1.8 m.

.4 Copper piping: up to NPS 1/2: every 1.5 m.

.5 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.

.6 Within 300 mm of each elbow.

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.4 m	1.8 m
1-1/2	3.0 m	2.4 m
2	3.0 m	2.4 m
2-1/2	3.7 m	3.0 m
3	3.7 m	3.0 m
3-1/2	3.7 m	3.3 m
4	3.7 m	3.6 m
5	4.3 m	
6	4.3 m	
8	4.3 m	
10	4.9 m	
12	4.9 m	

.7 Pipework 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 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:

.1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.8 CLEANING

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

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 The testing, adjusting and balancing for HVAC systems.

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):

.1 HVAC Applications Handbook, 2011, Chapter 38 – Testing, Adjusting and Balancing.

.2 Associated Air Balance Council (AABC):

.1 AABC National Standards for Total System Balance, 2002.

.2 AABC Test and Balance Procedures.

.3 Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA):

.1 Manual for the Balancing and Adjustment of Air Distribution Systems.

1.3 SCOPE OF WORK

.1 The mechanical contractor will contract with an independent testing, adjusting, and balancing (TAB) agency to test, adjust, and balance the HVAC systems.

.2 The Work included in this section consists of furnishing labour, instruments, and tools required in testing, adjusting and balancing the HVAC systems, as described in these specifications or shown on accompanying Drawings. Services shall include checking equipment performance, taking the specified measurements, and recording and reporting the results.

1.4 QUALIFICATIONS

.1 Agency Qualifications: The TAB Agency shall be a current member of the Associated Air Balance Council (AABC).

1.5 SUBMITTALS

.1 Qualifications: The TAB agency shall submit a company resume listing personnel and Project experience in air and hydronic system balancing and a copy of the agency's test and balance engineer (TBE) certificate.

.2 Submit names of personnel to perform TAB to Contract Administrator within thirty (30) days of award of Contract.

.3 Procedures and Agenda: The TAB agency shall submit the TAB procedures and agenda proposed to be used.

.4 Sample Forms: The TAB agency shall submit sample forms, which shall include the minimum data required by the AABC National Standards.

1.6 TAB PREPARATION AND COORDINATION

.1 Shop drawings, submittal data, up-to-date revisions, change orders, and other data required for planning, preparation, and execution of the TAB Work shall be provided to the TAB agency no later than 30 days prior to the start of TAB Work.

.2 System installation and equipment start-up to be complete prior to the TAB agency's being notified to begin.

.3 The building control system shall be complete and operational. The Building Control System contractor shall install all necessary components and software, and make these operational. Assistance shall be provided as required for reprogramming, coordination, and problem resolution.

.4 All test points, balancing devices, identification tags, etc. shall be accessible and clear of insulation and other obstructions that would impede TAB procedures.

.5 Qualified installation or start-up personnel shall be readily available for the operation and adjustment of the systems. Assistance shall be provided as required for coordination and problem resolution.

1.7 REPORTS

.1 Final TAB Report - The TAB agency shall submit the final TAB report for review by the Contract Administrator. All outlets, devices, HVAC equipment, etc., shall be identified, along with a numbering system corresponding to report unit identification. The TAB agency shall submit an AABC "National Project Performance Guaranty" assuring that the Project systems were tested, adjusted and balanced in accordance with the Project specifications and AABC National Standards.

1.8 DEFICIENCIES

.1 Any deficiencies in the installation or performance of a system or component observed by the TAB agency shall be brought to the attention of the Contract Administrator.

.2 The Work necessary to correct items on the deficiency listing shall be performed and verified by the affected contractor before the TAB agency returns to retest. Unresolved deficiencies shall be noted in the final report.

Part 2 Products

2.1 INSTRUMENTATION

.1 All instruments used for measurements shall be accurate and calibrated. Calibration and maintenance of all instruments shall be in accordance with the requirements of AABC National Standards.

Part 3 Execution

3.1 GENERAL

.1 The specified systems shall be reviewed and inspected for conformance to design documents. Testing, adjusting and balancing on each identified system shall be performed. The accuracy of measurements shall be in accordance with AABC National Standards. Adjustment tolerances shall be ±10% unless otherwise stated.

.2 Equipment settings, including manual valve indicators and similar controls and devices shall be marked to show final settings.

.3 All information necessary to complete a proper TAB Project and report shall be per AABC standards unless otherwise noted. The descriptions for Work required, as listed in this section, are a guide to the minimum information needed.

.4 Preconstruction Plan Check and Review:

.1 The TAB agency shall review the Project documents and contractor submittals for their effect on the TAB process and overall performance of the HVAC system. It shall submit recommendations for enhancements or changes to the system within 30 days of document review.

.5 Job Site Inspections:

.1 During construction, the TAB agency shall inspect the installation of pipe systems, sheet metal Work, temperature controls, and other component parts of the HVAC systems. Inspections shall be conducted a minimum of two times. (Typically, these are performed when 60% of the total system is installed and again when 90% of the total system is installed, prior to insulation of the piping). The TAB agency shall submit a written report of each inspection.

.6 Verification of HVAC Controls:

.1 The TAB agency shall be assisted by the building control systems contractor in verifying the operation and calibration of all HVAC and temperature control systems. The following tests shall be conducted:

.1 Verify that all control components are installed in accordance with Project requirements and are functional, including all electrical interlocks, and other safety devices.

.2 Verify that all controlling instruments are calibrated and set for design operating conditions.

.7 TAB Report Verification:

.1 At the time of final inspection, the TAB agency will be required to recheck, in the presence of the Contract Administrator, specific or random selections of data recorded in the certified report. Points and areas for recheck shall be selected by the Contract Administrator. Measurements and test procedures shall be the same as approved for the initial Work for the certified report. Selections for recheck, specific plus random, will not exceed one day on site.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 The supply and installation thermal insulation for ducting.

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

.1 ANSI/ASHRAE/IESNA 90.1, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 American Society for Testing and Materials International, (ASTM)

.1 ASTM B209M, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).

.2 ASTM C335, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.

.3 ASTM C411, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.4 ASTM C449/C449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.5 ASTM C612, Specification for Mineral Fiber Block and Board Thermal Insulation.

.3 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (R1999)

.5 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S701, Thermal Insulation Polystyrene, Boards and Pipe Covering.

1.3 DEFINITIONS

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED" - will mean "not concealed" as defined herein.

.3 Insulation systems - insulation material, fasteners, jackets, and other accessories.

1.4 SHOP DRAWINGS

.1 Submit for approval manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.

1.5 MANUFACTURERS' INSTRUCTIONS

.1 Installation instructions to include procedures used and installation standards achieved.

1.6 QUALIFICATIONS

.1 Installer: specialist in performing Work of this section, and have at least three years successful experience in this size and type of project, qualified to standards of TIAC.

1.7 DELIVERY, STORAGE AND HANDLING

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

.2 Protect from weather and construction traffic.

.3 Protect against damage from any source.

.4 Store at temperatures and conditions recommended 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: 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).

2.3 JACKETS

.1 VentureGuard 1574CW.

Part 3 Execution

3.1 PRE-INSTALLATION REQUIREMENTS

.1 Surfaces clean, dry, free from foreign material.

3.2 INSTALLATION

.1 Install in accordance with TIAC National Standards.

.2 Apply materials in accordance with manufacturer’s instructions and as indicated.

.3 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Hangers, supports to be outside vapour retarder jacket.

.4 Fasteners: At 300 mm o/c in horizontal and vertical directions, minimum two rows each side.

3.3 DUCTWORK INSULATION SCHEDULE

.1 Insulation types and thicknesses: Conform to following table:

Application	TIAC Code	Jacket	Thickness (mm)
Rectangular cold and dual temperature supply air ducts	C-1	yes	50
Exhaust duct between dampers and louvres	C-1	yes	50

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Copper piping valves and fittings for hydronic systems.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/American Welding Society (AWS)

.1 ANSI/AWS A5.8/A5.8M, Specification Filler Metals for Brazing and Bronze Welding.

.2 American Society of Mechanical Engineers (ASME)

.1 ANSI/ASME B16.4, Gray-Iron Threaded Fittings.
.2 ANSI/ASME B16.15, Cast Bronze Threaded Fittings.
.3 ANSI B16.18, Cast Copper Alloy, Solder Joint Pressure Fittings.
.4 ANSI/ASME B16.22, Wrought Copper and Copper-Alloy Solder Joint Pressure Fittings.

.3 American Society for Testing and Materials International (ASTM)

.1 ASTM B32, Standard Specification for Solder Metal.
.2 ASTM B61, Standard Specification for Steam or Valve Bronze Castings.
.3 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
.4 ASTM B88M, Standard Specification for Seamless Copper Water Tube [Metric].
.5 ASTM E202, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

.4 Manufacturers Standardization Society (MSS)

.1 MSS SP67, Butterfly Valves.
.2 MSS SP70, Cast Iron Gate Valves, Flanged and Threaded Ends.
.3 MSS SP71, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
.4 MSS SP80, Bronze Gate, Globe, Angle and Check Valves.
.5 MSS SP85, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

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. Include product characteristics, performance criteria, and limitations.

.2 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
.2 Indicate on manufacturers catalogue literature the following: VALVES.

.3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

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

.4 Closeout Submittals:

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

1.4 MAINTENANCE

.1 Extra Materials:

.1 Furnish following spare parts:

.1 Valve seats: one for every 10 valves, each size. Minimum one.

.2 Discs: one for every 10 valves, each size. Minimum one.

.3 Stem packing: one for every 10 valves, each size. Minimum one.

.4 Valve handles: two of each size.

.5 Gaskets for flanges: one for every 10 flanges.

Part 2 Products

2.1 TUBING

.1 Hard drawn copper tubing: to ASTM B88M.

2.2 FITTINGS

.1 Cast bronze threaded fittings: to ANSI/ASME B16.15.

.2 Wrought copper and copper alloy solder joint pressure fittings: to ANSI/ASME B16.22.

.3 Cast iron threaded fittings: to ANSI/ASME B16.4.

.4 Cast copper alloy solder joint pressure fittings: to ANSI B16.18.

2.3 FLANGES

.1 Brass or bronze: threaded.

.2 Cast iron: threaded.

.3 Orifice flanges: slip-on, raised face, 2100 kPa.

2.4 JOINTS

.1 Solder, tin-antimony, 95:5: to ASTM B32.

.2 Silver solder BCUP: to ANSI/AWS A5.8.

.3 Brazing: as indicated.

2.5 VALVES

.1 Connections:

.1 NPS 2 and smaller: ends for soldering.
.2 NPS 2 1/2 and larger: ends.

.2 Gate Valves (Application: isolating equipment, control valves, pipelines):

.1 NPS 2 and under:
.1 Class 125, non-rising stem, solid wedge disc.
.2 NPS 2 1/2 and over:
.1 Non-rising stem, solid wedge disc, bronze trim.

.3 Butterfly valves (Application: isolating each cell or section of multiple component equipment):

.1 NPS 2 1/2 and over: lug type.

.4 Globe valves: (application: throttling, flow control, emergency bypass):

.1 NPS 2 and under:
.1 Globe, with composition disc.
.2 NPS 2 1/2 and over:
.1 With bronze disc, bronze trim.

.5 Balancing, for TAB:

.1 Sizes: calibrated balancing valves, as specified.
.2 NPS 2 and under:
.1 Globe, with plug disc.

.6 Drain valves: gate, Class 125, non-rising stem, solid wedge disc.

.7 Swing check valves:

.1 NPS 2 and under:
.1 Class 125, swing, with composition disc.
.2 NPS 2 1/2 and over:
.1 Flanged ends.

.8 Silent check valves:

.1 NPS 2 1/2 and over:
.1 Flanged ends.

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 INSTALLATION

.1 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.

.2 Install concealed pipes close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping where ever practical.

.3 Slope piping in direction of drainage and for positive venting.

.4 Use eccentric reducers at pipe size change installed to provide positive drainage or positive venting.

.5 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.

.6 Assemble piping using fittings manufactured to ANSI standards.

3.3 VALVE INSTALLATION

.1 Install rising stem valves in upright position with stem above horizontal.

.2 Install ball or butterfly valves at branch take-offs and to isolate each piece of equipment.

.3 Install globe valves for balancing.

.4 Install plug cocks or ball valves for glycol service.

3.4 CIRCUIT BALANCING VALVES

.1 Remove handwheel after installation and TAB is complete.

.2 Tape joints in prefabricated insulation on valves installed in chilled watermains.

3.5 FLUSHING AND CLEANING

.1 Flush after pressure test for a minimum of four hours.

.2 Fill with solution of water and non-foaming, phosphate-free detergent 3% solution by weight. Circulate for minimum of eight hours.

.3 Refill system with clean water. Circulate for at least four hours. Clean out strainer screens/baskets regularly. Then drain.

.4 Refill system with clean water. Circulate for at least two hours. Clean out strainer screens/baskets regularly. Then drain.

.5 Drainage to include drain valves, dirt pockets, strainers, low points in system.

.6 Re-install strainer screens/baskets only after obtaining Contract Administrator's approval.

3.6 FILLING OF SYSTEM

.1 Refill system with glycol.

3.7 FIELD QUALITY CONTROL

.1 Testing:

.1 Test system in accordance with Section 23 05 01 - Common Work Results - Mechanical.

.2 For glycol systems, retest with propylene glycol to ASTM E202, inhibited, for use in building system after cleaning. Repair leaking joints, fittings or valves.

.2 Balancing:

.1 Balance water systems to within plus or minus 5% of design output.

.3 Glycol Charging:

.1 Provide mixing tank and positive displacement pump for glycol charging.

.2 Retest for concentration to ASTM E202 after cleaning.

.3 Provide report to Contract Administrator.

3.8 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 of low-pressure metallic ductwork, joints and accessories.

1.2 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).

.2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

1.3 SUBMITTALS

.1 Submit shop drawings and product data in accordance with Section 01 33 00 – Submittal Procedures.

Part 2 Products

2.1 SEAL CLASSIFICATION

.1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
500	C
250	C
125	C
125	Unsealed

.2 Seal classification:

.1 Class C: transverse joints and connections made air tight with sealant or combination thereof. Longitudinal seams unsealed.

.2 Unsealed seams and joints.

2.2 SEALANT

.1 Sealant: oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of -30°C to +93°C.

2.3 DUCT LEAKAGE

.1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

2.4 FITTINGS

.1 Fabrication: to SMACNA.

2.5 FIRE STOPPING

.1 Fire stopping material and installation must not distort duct.

2.6 GALVANIZED STEEL

.1 Lock forming quality: to ASTM A653/A653M, Z90 zinc coating.

.2 Thickness, fabrication and reinforcement: to SMACNA.

.3 Joints: to SMACNA.

2.7 HANGERS AND SUPPORTS

.1 Hangers and Supports:

.1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.

.2 Hanger configuration: to ASHRAE and SMACNA.

.3 Hangers: galvanized steel angle with galvanized steel rods to ASHRAE and SMACNA following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6

Part 3 Execution

3.1 GENERAL

.1 Work in accordance with ASHRAE and SMACNA.

.2 Do not break continuity of insulation vapour barrier with hangers or rods.

3.2 HANGERS

.1 Strap hangers: install in accordance with SMACNA.

.2 Angle hangers: complete with locking nuts and washers.

.3 Hanger spacing: in accordance with as follows:

Duct Size (mm)	Spacing (mm)
to 1500	3000

3.3 SEALING AND TAPING

.1 Apply sealant to outside of joint to manufacturer's recommendations.

3.4 LEAKAGE TESTS

.1 In accordance with SMACNA HVAC Duct Leakage Test Manual.

.2 Make trial leakage tests as instructed to demonstrate workmanship.

.3 Complete test before performance insulation or concealment Work.

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.

1.2 REFERENCES

.1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):

.1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

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 O&M manual.

Part 2 Products

2.1 GENERAL

.1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 FLEXIBLE CONNECTIONS

.1 Frame: galvanized sheet metal frame 1.3 mm thick with fabric clenched by means of double locked seams.

.2 Material:

.1 Fire resistant, self-extinguishing, neoprene coated glass fabric, temperature rated at -40°C to 90°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 or foam rubber.

.4 Hardware:

.1 Up to 300 x 300 mm: two sash locks complete with safety chain.
.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.
.5 Hold open devices.
.6 300 x 300 mm glass viewing panels.

2.4 TURNING VANES

.1 Factory or shop fabricated single thickness without trailing edge, 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 galvanized sheet metal spin-in collars with lockable butterfly damper.

.2 Sheet metal thickness to co-responding round duct standards.

Part 3 Execution

3.1 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 Size:

.1 600 x 600 mm for person size entry.

.2 300 x 300 mm for servicing entry.

.3 150 x 150 mm for viewing.

.4 As indicated.

.2 Locations:

.1 Fire and smoke dampers.

.2 Control dampers.

.3 Devices requiring maintenance.

.4 Required by code.

.5 Reheat coils.

.6 Elsewhere as indicated.

.3 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 In mixed air applications in locations as approved by Contract Administrator.

.3 At inlet and outlet of coils.

.4 Downstream of junctions of two converging air streams of different temperatures.

.5 And as indicated.

.4 Turning vanes:

.1 Install in accordance with recommendations of SMACNA and as indicated.

3.3 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 Operating dampers for mechanical forced air ventilation and air conditioning systems.

1.2 SUBMITTALS

.1 Product Data:

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

.2 Submit manufacturer's printed product literature, specifications and datasheet. Include product characteristics, performance criteria, and limitations.

.3 Indicate the following:

.1 Performance data.

.2 Quality assurance submittals:

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

.2 Instructions: submit manufacturer's installation instructions.

.3 Closeout Submittals

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

1.3 QUALITY ASSURANCE

.1 Certificates:

.1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency.

Part 2 Products

2.1 MULTI-LEAF DAMPERS

.1 Extruded aluminum (6063T5) damper frame shall not be less than 2.03mm (0.080") in thickness. Damper frame to be 101.6mm (4") deep.

.2 Blades to be extruded aluminum (6063T5) profiles, 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.

.3 Blade and frame seals shall be of extruded silicone and be secured in an integral slot within the aluminum extrusions.

.4 Bearings are to be composed of a Celcon inner bearing fixed to an 11.1 mm (7/16") aluminum hexagon blade pin, rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal or metal-to-plastic contact.

.5 Linkage hardware shall be installed in the frame side and constructed of aluminum and corrosion-resistant, stainless steel, complete with cup-point trunnion screws for a slip-proof grip.

.6 Dampers are to be designed for operation in temperatures ranging between -40°C (-40°F) and 85°C (185°F).

.7 Dampers shall be parallel blade action.

.8 Leakage shall not exceed 15.2 l/s/m² (3 cfm/ft²) against 250Pa (1” w.g) differential static pressure.

.9 Leakage shall not exceed 25 l/s/m² (4.9 cfm/ft.²) against 1kPa (4" w.g) differential static pressure at -40°C (-40°F).

.10 Pressure drop of a fully open 1220mm x 1220mm (48" x 48") damper shall not exceed 7Pa (0.03" w.g). at 5.08m/s (1000 fpm).

.11 Dampers shall be made to size required without blanking off free area.

.12 Dampers shall be "Flanged to Duct".

.13 Acceptable Material: Alumavent, Tamco, Ventex.

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.

.5 Ensure dampers are observable and accessible.

END OF SECTION

PART 1 General

1.1 REFERENCES

.1 American Gas Association (AGA)

.2 American National Standards Institute/Air-Conditioning, Heating and Refrigeration Institute (ANSI/AHRI)

.1 ANSI/AHRI 210/240, Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.

.2 ANSI/AHRI 270, Sound Rating of Outdoor Unitary Equipment.

.3 CSA Group

.1 CSA B52, Mechanical Refrigeration Code.

.2 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

.4 National Fire Protection Association (NFPA)

.1 NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.

.5 Underwriters Laboratories (UL)

.1 UL 1995, Standard for Heating and Cooling Equipment.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Shop Drawings:

.1 Submit drawings for all units.

.2 Submit manufacturer's instructions, printed product literature and data sheets for outdoor HVAC equipment and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Drawings to indicate project layout and dimensions; indicate:

.1 Equipment, piping, and connections, together with valves, strainers, control assemblies, thermostatic controls, auxiliaries and hardware, and recommended ancillaries which are mounted, wired and piped ready for final connection to building system, its size and recommended bypass connections.

.2 Piping, valves, fitting shipped loose showing final location in assembly.

.3 Control equipment shipped loose, showing final location in assembly.

.4 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, mounting curb details, sizes and location of mounting bolt holes; include mass distribution drawings showing point loads.

.5 Detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices of ancillaries, accessories, controllers.

.6 Pump and fan performance curves.

.7 Details of vibration isolation.

.8 Estimate of sound levels to be expected across individual octave bands in dB referred to A rating.

.9 Type of refrigerant used.

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

.3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.4 Manufacturer's Field Reports:

.1 Submit manufacturer's field reports.

1.3 CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data: submit operation and maintenance data for outdoor HVAC equipment for incorporation into manual.

.1 Indicate: brief description of unit, indexed, with details of function, operation, control, and service for components.

.2 Provide for units, manufacturer's name, type, year, number of units, and capacity.

1.4 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 dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect outdoor HVAC equipment from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

PART 2 Products

2.1 GENERAL

.1 AHU-M639:

.1 Roof-mounted, self-contained single zone makeup air unit with DX refrigeration, minimum 90% efficient natural gas heat exchanger and bear label of CSA, and CGA.

.2 Unit to consist of cabinet and frame, supply fan, heat exchanger, burner, winter and summer air filter sections, refrigerant cooling coil, compressor, condenser coil and fans, motorized outside air damper.

.3 Prefabricated roof curb (where required) to conform to requirements of National Roofing Contractors Association (NRCA), height as indicated.

.4 Conform to ANSI/AHRI 210/240, rating for unit larger than 40 kW nominal.

.2 AHU-M651:

.1 Roof mounted, self-contained single zone VAV unit with hydronic heating coil and DX refrigeration and bear label of CSA.

.2 Units to consist of cabinet and frame, supply and return fan with variable speed drives, heating coil, air filter, refrigerant cooling coil, compressor, condenser coil and fans, motorized outside air damper, return damper, gravity exhaust damper.

.3 Prefabricated roof curb to conform to requirements of National Roofing Contractors Association (NRCA), minimum height 300 mm.

.4 Conform to ANSI/AHRI 210/240, rating for unit larger than 40 kW nominal.

2.2 CABINET

.1 Cabinets: weatherproofing tested and certified to AGA and soundproofing tested to AHRI 270.

.2 Framing and supports: 2 mm thick welded steel, galvanized after manufacture, with lifting lugs.

.3 Outer casing: weathertight, galvanized steel with baked enamel finish, complete with flashing.

.4 Access: gasketted hinged doors, with locking door handle type fasteners.

.5 Insulation: neoprene coated glass fiber on surfaces where conditioned air is handled, 50 mm thick, 32 kg/m^3 density.

2.3 FANS

.1 Centrifugal, forward curved impellers, statically and dynamically balanced. V-belt drive with adjustable variable pitch motor pulley.

2.4 AIR FILTERS

.1 50 mm thick MERV 8, metal framed, throwaway, standard to unit manufacturer. AHU-M639 to also have washable pre-filter.

.2 To meet NFPA 90A, air filter requirements.

2.5 HEAT EXCHANGERS AND BURNERS

.1 Gas fired, multiple flue passes, with primary heating surface of stainless steel.

.1 Gas burner: factory mounted, wired and fire tested complete with operating and safety controls.

.2 Forced type.

.3 Spark ignited pilot with pilot flame safety shut-off.

.4 Condensate drain: easily cleanable or removable for cleaning. Drain connection complete with trap. Locate in warm area within roof curb envelope to prevent freezing.

2.6 HYDRONIC COILS

.1 Aluminum fins, mechanically bonded to copper tubes.

.2 Piping: complete with modulating control valve, shut off valves, drain valves, unions or flanges.

.3 Heresite-coated to resist corrosion from any fugitive airborne H_2S.

.4 Hydrostatically tested to 1.7 MPa.

2.7 REFRIGERATION

.1 Conform to MECB 2011, CSA B52, and UL 1995 requirements.

.2 Compressor/Condenser Section:

.1 compressor, vibration isolated with flexible suction and discharge connections, oil sight glass, oil pressure switch, crankcase heater, with control to liquid line solenoid valve.

.2 Fan: propeller type with single piece spun venturi outlets and zinc plated guards. Motor: sequenced for head pressure control.

.3 Electrical system: complete with operating controls, oil and refrigerant pressure protection, motor overload protection, weatherproof electrical wiring with weatherproof, disconnect.

.4 Include refrigerant piping with sight glass, filter and valves.

.5 Condenser: staggered copper tube aluminum fin coil assembly with sub-cooling rows.

.6 Heresite-coated to resist corrosion from any fugitive airborne H_2S.

.3 Evaporator:

.1 Rated to ANSI/AHRI 210/240.

.2 Thermostatic expansion valve, with adjustable super heat and external equalizer.

.3 Cooling coil condensate drain pans: designed to avoid standing water, easily cleanable or removable for cleaning. Drain connection complete with trap.

.4 Heresite-coated to resist corrosion from any fugitive airborne H_2S.

2.8 CONTROLS

.1 Controls for units shall have a local user interface and shall be capable of communicating via Modbus TCP to a PLC monitoring system. Refer to Division 29.

.2 In addition to combustion safety controls complete with a local start switch for burner, provide low limit on supply and freeze protection.

.3 Provide communications control interface for full control, monitoring, and alarm notification through PLC monitoring system.

.4 Provide shop drawing with complete mapping of Modbus register address.

.5 Single Zone Heating/Cooling Control:

.1 Zone sensor to activate burner modulation or refrigeration system and supply fan to maintain temperature setting. Automatic heating/cooling mode changeover based on outside air temperature.

.2 Cooling:

.1 Zone sensor to activate cooling relay in control circuit cycling compressor. Provide safeties and pressure controls. Condenser fans to operate in sequence.

.2 As back pressure is reduced, hot gas bypass opens to maintain set back pressure.

.3 When call for cooling is satisfied, relay is de-energized closing liquid line solenoid valve.

.6 Mixed Air Single Zone Unit:

.1 Automatic outside and return air dampers for fixed outside air quantity.

.2 Remote controlled outside air dampers with damper operator and remote rheostat package for adjusting outside air quantity.

.3 Motorized outside, return and gravity relief dampers with spring return damper operator and control package to automatically vary outside air quantity. Outside air and exhaust air dampers, normally closed.

.4 Tight fitting opposed blade dampers with neoprene or suitable gaskets, bushings and 1% maximum leakage.

.5 Damper operation: 24 V, spring return motor with gear train sealed in oil.

.6 Mixed air controls: maintain indicated mixed air temperature, lock out compressor below 14°C ambient, restart 17°C.

.7 Automatic heating/cooling mode changeover based on thermostat.

.7 Alarms to DCS (via PLC):

.1 Low temperature freeze alarm. No local manual reset on unit.

2.9 CAPACITY

.1 As indicated on drawings.

2.10 MANUFACTURERS

.1 Manufacturer of air handling and makeup air units shall have local service representation and technical support within the City of Winnipeg.

.2 Standard of Acceptance: Engineered Air, ICE, McQuay, Price, Trane, York.

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 outdoor HVAC equipment installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate.

.2 Inform Contract Administrator of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

.1 Install as per manufacturers' instructions on roof curbs as indicated.

.2 Manufacturer to certify installation, supervise start-up and commission unit.

.3 Run drain line from cooling coil condensate drain pan to discharge.

3.3 FIELD QUALITY CONTROL

.1 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 After delivery and storage of products, and when preparatory Work on which Work of this Section depends is complete, but before installation begins.

.2 Upon completion of Work, after cleaning is carried out.

.2 Obtain reports and submit immediately to Contract Administrator.

.3 Performance Verification:

.1 Rooftop Air Handling Units:

.1 Set zone mixing dampers for full cooling, except that where diversity factor forms part of design set that percentage of zone dampers to full heating.

.2 Set outside air and return air dampers for minimum outside air.

.3 Set face and bypass dampers so face dampers are fully open and bypass dampers are fully closed.

.4 Check for smooth, vibration less correct rotation of supply fan impeller.

.5 Measure supply fan capacity.

.6 Adjust impeller speed as necessary and repeat measurement of fan capacity.

.7 Measure pressure drop each component of air handling unit.

.8 Set outside air and return air dampers for the percentage of outside air required by design and repeat measurements of fan capacity.

.9 Reduce differences between fan capacity at minimum and maximum outside air less than 5%.

.10 Set face and bypass dampers to full bypass and repeat measurement of fan capacity.

.11 Reduce difference between fan capacity with F BPD fully closed to bypass and fully open to bypass to less than 5%.

.12 Reduce difference between fan capacity at full cooling and fan capacity at full heating to less than 5%.

.13 OAD: verify for proper stroking, interlock with RAD.

.14 Measure DBT, WBT of SA, RA, EA.

.15 Measure air cooled condenser discharge DBT.

.16 Measure flow rates (minimum and maximum) of SA, RA, EA, relief air.

.17 Simulate maximum cooling load and measure refrigerant hot gas and suction temperatures and pressures.

.18 Use smoke test to verify no short-circuiting of EA, relief air to outside air intake or to condenser intake.

.19 Simulate maximum heating load and:

.1 Verify temperature rise across heat exchanger.

.2 Perform flue gas analysis. Adjust for peak efficiency.

.3 Verify combustion air flow to heat exchanger.

.4 Simulate minimum heating load and repeat measurements.

.20 Measure radiated and discharge sound power levels under maximum heating demand and under maximum cooling demand with compressors running.

.21 Verify operating control strategies, including:

.1 Heat exchanger operating and high limit.

.2 Early morning warm-up cycle.

.3 Freeze protection.

.4 Economizer cycle operation, temperature of change-over.

.5 Alarms.

.6 Voltage drop across thermostat wiring.

.7 Operation of remote panel including pilot lights, failure modes.

.22 Set zone mixing dampers for full heating and repeat measurements.

.23 Measure leakage past zone mixing dampers by taking temperature measurements. Reduce leakage to less than 5%.

.24 Measure return fan capacity.

.25 Adjust impeller speed as necessary and repeat measurement of return fan capacity.

.26 Check capacity of heating unit.

.27 Measure DX refrigeration system performance.

.28 Refer to other sections of these specifications for PV procedures for other components.

.2 Start-Up:

.1 Verify accessibility, serviceability of components including motorized dampers, filters coils, fans, motors, operators, sensors, electrical disconnects.

.2 Verify accessibility, clean ability, drainage of drain pans for coils.

3.4 CLEANING

.1 Perform cleaning operations in accordance with manufacturer's recommendations.

3.5 DEMONSTRATION AND TRAINING

.1 Provide demonstration and training as per Section 01 79 00.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 General requirements that are common to NMS sections found in Division 26.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

.2 CAN3-C235, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

.2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)

.1 EEMAC 2Y-1, Light Gray Colour for Indoor Switch Gear.

.3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.4 City of Winnipeg Water and Waste Department – Electrical Design Guide, Rev 01

.5 City of Winnipeg Water and Waste Department – Automation Design Guide, Rev 00

.6 City of Winnipeg Water and Waste Department – Identification Standard, Rev 00

1.3 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 for control items in English.

1.4 SUBMITTALS

.1 Quality Control:

.1 Provide CSA certified equipment and material.

.2 Where CSA certified equipment and material is not available, submit such equipment and material to authority having jurisdiction for special approval before delivery to Site.

.3 Submit test results of installed electrical systems and instrumentation.

.4 Permits and fees: in accordance with General Conditions of Contract.

.5 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Contract Administrator.

.2 Manufacturer's Field Reports: submit to Contract Administrator manufacturer's written report, within three days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in Part 3 - Field Quality Control.

1.5 QUALITY ASSURANCE

.1 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction 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.

1.6 SYSTEM STARTUP

.1 Instruct City's personnel in operation, care and maintenance of systems, system equipment and components.

.2 Assist City's personnel and the Contract Administrator in the start-up of equipment.

.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 will aspects of its care and operation.

Part 2 Products

2.1 MATERIALS AND EQUIPMENT

.1 Products shall be in compliance with the Contractor Supplied Standardized Goods as outlined in Section E9, E10, and E11 of the Bid Opportunity.

.2 Material and equipment to be CSA certified. Where CSA certified material and equipment are not available, obtain special approval from authority having jurisdiction 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 Division 29.

2.3 WARNING SIGNS

.1 Warning Signs: in accordance with requirements of inspection authorities.

.2 Lamacoid 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 as follows:

.1 Nameplates: lamicoid 3 mm thick plastic engraving sheet, white with black core, lettering accurately aligned and engraved into core mechanically attached with self-tapping stainless steel screws.

.2 Lamacoids as follows:

Application	**Text Size**	**Text**
Electrical Equipment - General	5 mm	Line 1: Identifier
Circuit Breaker - Separate	5 mm	Line 1: Identifier Line 2: Load Identifier Line 3: Load Description
Disconnect Switch - Separate	5 mm	Line 1: Identifier Line 2: Load Identifier Line 3: Load Description
Fire Alarm Devices	8 mm	Line 1: Identifier
Light Switches	3 mm	Source Panel and Circuit Number
Motor Control Centre	8 mm	Line 1: Identifier Line 2: Description Line 3: System Voltage Line 4: Fed By
Motor Starter or MCC Bucket	5 mm	Line 1: Load Identifier Line 2: Load Description
Panelboards	8mm	Line 1: Identifier Line 2: Description Line 3: System Voltage Line 4: Fed By
Receptacles	3 mm	Source Panel and Circuit Number
Switchgear	8 mm	Line 1: Identifier Line 2: Description Line 3: System Voltage Line 4: Fed By
Switchgear Breaker	8 mm	Line 1: Identifier Line 2: Description Line 3: System Voltage Line 4: Fed By
Transformer - Indoor	8 mm	Line 1: Identifier Line 2: Rating, System Voltage Line 3: Fed By
Transformer – Outdoor	10 mm	Line 1: Identifier Line 2: Rating, System Voltage Line 3: Fed By

.2 Wording on nameplates to be approved Contract Administrator prior to manufacture.

2.6 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour coding: to CSA C22.1.

.4 Use colour coded wires in communication cables, matched throughout system.

2.7 CONDUIT AND CABLE IDENTIFICATION

.1 Colour code conduits, boxes and metallic sheathed cables.

.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

.3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

.4 Colour Codes

	Prime	Auxiliary
Power, 120/208/240 VAC	Black	
UPS Power, 120/208/240 VAC	Black	Green
Control Wiring, 120VAC	Black	Orange
Fire Alarm	Red	
Low Voltage Communication/General	Blue	
Low Voltage Control Wiring, <50 V	Blue	Orange
Intrinsically Safe	Blue	White
up to 250 V	Yellow	
up to 600 V	Yellow	Green
Other Communication Systems	Green	Blue

.5 Cable Colour Codes

	Prime	Auxiliary
Power, 120/208/240 VAC	Black	
UPS Power, 120/208/240 VAC	Black	Green
Control Wiring, 120VAC	Black	Orange
Fire Alarm	Red	
Low Voltage Communication/General	Blue	
Low Voltage Control Wiring, <50 V	Blue	Orange
Intrinsically Safe	Blue	White
up to 600 V	Yellow	Green
Other Communication Systems	Green	Blue

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.

.1 Paint outdoor electrical equipment "equipment green" finish.

.2 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1.

Part 3 Execution

3.1 INSTALLATION

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

.2 Do overhead and underground systems in accordance with CSA C22.3 No.1 except where specified otherwise.

3.2 NAMEPLATES AND LABELS

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

3.3 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

.3 Install electrical equipment at following heights unless indicated otherwise.

- .1 Local switches: 1400 mm.
- .2 Wall receptacles:
  - .1 General: 300 mm.
  - .2 In mechanical rooms: 1400 mm.
- .3 Panelboards: as required by Code or as indicated.
- .4 Control panels: as indicated.

3.4 CO-ORDINATION OF PROTECTIVE DEVICES

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

3.5 FIELD QUALITY CONTROL

.1 Conduct following tests:

- .1 Circuits originating from branch distribution panels.
- .2 Lighting and its control.
- .3 Insulation resistance testing:
  - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
  - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
  - .3 Check resistance to ground before energizing.

.2 Carry out tests in presence of Contract Administrator.

.3 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of Project.

3.6 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 SECTION INCLUDES

.1 Materials and installation for wire and box connectors.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.2No.18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.

.2 CSA C22.2No.65, Wire Connectors.

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

.1 EEMAC 1Y-2, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

.3 National Electrical Manufacturers Association (NEMA)

Part 2 Products

2.1 MATERIALS

.1 Pressure type wire connectors to: CSA C22.2No.65, with current carrying parts of copper sized to fit copper conductors as required.

.2 Fixture type splicing connectors to: CSA C22.2No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

.3 Bushing stud connectors: to EEMAC 1Y-2 to consist of:

.1 Connector body and stud clamp for stranded copper conductors.

.2 Clamp for stranded copper conductors.

.3 Stud clamp bolts.

.4 Bolts for copper conductors.

.5 Sized for conductors as indicated.

.4 Clamps or connectors for armoured cable, flexible conduit, non-metallic sheathed cable as required to: CAN/CSA-C22.2No.18.

Part 3 Execution

3.1 INSTALLATION

.1 Remove insulation carefully from ends of conductors and:

.1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.

.2 Install fixture type connectors and tighten. Replace insulating cap.

.3 Install bushing stud connectors in accordance with EEMAC 1Y-2.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

1.2 REFERENCES

.1 CSA C22.2 No .0.3, Test Methods for Electrical Wires and Cables.

.2 CAN/CSA-C22.2 No. 131, Type TECK 90 Cable.

Part 2 Products

2.1 TECK CABLE

.1 Cable: to CAN/CSA-C22.2 No. 131.

.2 Conductors:

.1 Grounding conductor: copper.

.2 Circuit conductors: copper, size as indicated.

.3 Insulation:

.1 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 stainless steel straps to secure surface cables 50 mm and smaller. Two-hole stainless steel straps for cables larger than 50 mm.

.2 Channel type supports for two or more cables at 900 mm centers.

.3 Stainless steel threaded rods: 6 mm dia. to support suspended channels.

.8 Connectors

2.2 CONTROL CABLES

.1 Type LVT: soft annealed copper conductors, sized as indicated, with thermoplastic insulation, outer covering of thermoplastic jacket.

.2 600 V type: stranded annealed copper conductors, sizes as indicated with PVC insulation type TW, or cross-linked polyethylene type RW90 (x-link with shielding ofmetallized tapes over each pair of conductors and overall covering of thermoplastic jacket interlocked armour and jacket over sheath of PVC.

Part 3 Execution

3.1 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.

3.2 INSTALLATION OF CONTROL CABLES

.1 Install control cables in conduit.

.2 Ground control cable shield.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Not Used

Part 2 Products

2.1 SUPPORT CHANNELS

.1 U shape aluminum, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended.

Part 3 Execution

3.1 INSTALLATION

.1 Secure equipment to hollow or solid masonry, tile and plaster surfaces with lead anchors.

.2 Secure equipment to poured concrete with expandable inserts.

.3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.5 Fasten exposed conduit or cables to building construction or support system using straps.

- .1 One-hole stainless steel straps to secure surface conduits and cables 50 mm and smaller.
- .2 Two-hole stainless steel straps for conduits and cables larger than 50 mm.
- .3 Beam clamps to secure conduit to exposed steel work.

.6 Suspended support systems.

- .1 Support individual cable or conduit runs with 6 mm dia. threaded rods and spring clips.
- .2 Support two or more cables or conduits on channels supported by 6 mm dia. threaded rod hangers where direct fastening to building construction is impractical.

.7 For surface mounting of two or more conduits use channels at 1 m on centre spacing.

.8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.10 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Contract Administrator.

.12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data for cabinets in accordance with Section 01 33 00 - Submittal Procedures.

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.

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.

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, two keys, containing sheet steel backboard for surface mounting.

Part 3 Execution

3.1 SPLITTER INSTALLATION

.1 Install splitters and mount plumb, true and square to the building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 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 00 - Common Work Results - Electrical.

.2 Install size two identification labels indicating system name, voltage and phase.

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 00 - Common Work Results - For Electrical.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA C22.2 No.4-M89 (R2000), Enclosed Switches.

.2 CSA C22.2 No.39-M89 (R2003), Fuseholder Assemblies.

1.4 SUBMITTALS

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

Part 2 Products

2.1 DISCONNECT SWITCHES

.1 Heavy duty non-fusible, horsepower rated disconnect switch to CAN/CSA C22.2 No.4.

.2 Provision for padlocking in OFF position.

.3 Quick-make, quick-break action.

.4 ON-OFF switch position indication on switch enclosure cover.

.5 Category 1 locations: NEMA 4.

.6 Category 2 locations: NEMA 4x.

.7 Ordinary locations: NEMA 12.

.8 Outdoor: NEMA 3.

.9 Acceptable Manufacturer: Square D, Eaton, Hubbell, Pass & Seymour, Leviton.

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - For Electrical.

Part 3 Execution

3.1 INSTALLATION

.1 Install disconnect switches as indicated and as required by CSA C22.1.

END OF SECTION

Part 1 General

1.1 REQUIREMENTS OF WORK

.1 Install and assist in commissioning a complete instrumentation and control (I&C) system for AHU-M369 and AHU-M651 as shown on the Drawings and as specified herein.

.2 Component subsystems of the I&C system will include, but are not limited to, the following:

- .1 Primary elements and transmitters;
- .2 Final control elements;
- .3 PLC control panels;
- .4 Operator graphic interface;
- .5 Instrumentation cabling;
- .6 Instrumentation power supplies; and,
- .7 Conduit and cable tray.

.3 Where packaged, stand-alone control systems are supplied by others provide cabling to connect to the required remote monitoring and/or control functions. Provide end-to-end Commissioning of all required remote monitoring and/or control functions. Assist in ensuring the correct functionality of any equipment supplied by others.

.4 Documentation provided is formatted as follows:

- .1 Location Drawings – indicate in plan and/or elevation views where the instrument elements are physically located. These Drawings are provided to assist the Contractor in estimating the amount of cable and ducting required.
- .2 Standard Details – provide a reference for installation, operation and other instructions pertinent to a particular device.
- .3 Detailed Specification – lists qualifications, quality of materials and workmanship, and supplementary information.

.5 Definitions

- .1 Interpret specialized terms not explicitly defined herein in accordance with ISA-S51.1, NEMA-ICS-1, ANSI/IEEE-Std-100, and The Communications Standard Dictionary, by Martin H. Weik.

.6 References

- .1 This Specification contains references to the following Documents. They are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of the listed Documents, the requirements of this Section prevail.

Reference	**Title**
API RP550-86	Manual on Installation of Refinery Instruments and Control Systems, Part I--Process Instrumentation and Control Sections 1 Through 13
ASME Section VII-89	Rules for Construction of Pressure Vessels
ASTM B68-86	Seamless Copper Tube
ASTM D883-89	Terms Relating to Plastics
IEEE 100-88	Dictionary of Electrical and Electronic Terms
ISA RP7.1-56	Pneumatic Control Circuit Pressure Test
ISA RP12.6-87	Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations
ISA S5.4-76	Instrument Loop Diagrams
ISA S18.1-79	Annunciator Sequences and Specifications
ISA S51.1-79	Process Instrumentation Terminology
NEMA 250-85	Enclosures for Industrial Controls and Systems
NEMA ICS 1-88	General Standards for Industrial Control and Systems
NEMA ICS 2-88	Industrial Control Devices, Controllers, and Assemblies
NFPA 70-90	National Electrical Code (NEC)
SAMA PMC 17-10-63	Bushings and Wells for Temperature Sensing Elements
UBC-88	Uniform Building Code
UL 1012-89	Power Supplies
UL 94-80	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances Weik, Martin H. Communications Standard Dictionary, Van Nostrand Reinhold Co., 1983

.7 Related Work:

.1 Mechanical

.2 Electrical

.8 Qualifications

.1 The instrumentation Subcontractor shall be a firm normally engaged and fully competent in the type of Work described in this Section of the Specification. The firm shall have been continuously and successfully engaged in this business for at least five years.

.2 Qualified journeyman instrument mechanics that are familiar with the devices being installed shall perform all instrument hook-ups, calibrations, and checkouts.

.3 Qualified journeyman electricians shall perform all control wiring installation and connections.

.9 Codes, Rules, Permits and Fees

.1 Comply with all laws, ordinances, rules, regulations, codes and orders of all authorities having jurisdiction relating to this Work.

.2 Comply with all rules of the Electrical Safety Act of the Province, CSA Standards, the ULC and the applicable building codes, whether specifically shown on Drawings or not.

.3 Give all required notices, submit Drawings, obtain all permits, licenses and certificates and pay all fees required for this Work.

.4 Furnish a certificate of final inspection and approvals from an inspection authority to the Contract Administrator.

.10 Standards of Workmanship

.1 Execute all Work in a manner, which will result in the completed installation presenting an acceptable appearance, to a level of quality defined in the general conditions of this Specification.

.2 Employ a competent supervisor and all necessary licensed tradesmen to complete the Work in the required time.

.3 Arrange and install products to fit properly into designated building spaces.

.4 Install products in accordance with the recommendations and ratings of the product manufacturers.

.11 Contract Drawings and Specifications

.1 Refer to Division 1.

.2 Provide all items and accessories required to install City supplied equipment.

.3 Perform all operations as designated by the Specification according to the methods prescribed, complete with all necessary labour and incidentals.

.4 Treat any item or subject omitted from this Division's Specifications or Drawings, but which is mentioned or reasonably specified in other Divisions' Specifications or Drawings and pertains to the instrumentation and control system, as being integral to the overall system. Provide such specified items or subjects.

.5 Provide all minor items and Work not shown or specified but which are reasonably necessary to complete the Work.

.6 If discrepancies or omissions in the Drawings or Specifications are found, or if intent or meaning is not clear, consult the Contract Administrator for clarification before submitting bid.

1.2 EQUIPMENT

.1 Receiving, Storing, and Protection of Components during Construction

.1 Examine each component upon delivery to Site. Report all damage noted to the Contract Administrator prior to accepting or rejecting delivery. All instrumentation primary elements, control components, panels, etc. shall be placed in a secure, dry, heated storage building. Maintain the space temperature above 10°C and the space relative humidity below 50 percent.

.2 Perform a preliminary examination upon delivery to ensure that:

.1 All instrumentation and control components supplied for this Project under this Section of the Specification comply with the requirements stated in the instrument Specification sheets.

.2 All instrumentation and control components supplied by others, to be connected to instrumentation and control components comply with the requirements stated in the Contract Documents.

.3 Itemize all non-conformities noted above and forward them to the Contract Administrator.

.4 Do not install primary elements or other sensitive equipment until construction is sufficiently completed to provide an "operating condition" environment. Notify the Contract Administrator prior to installing any equipment of this type.

.5 Ensure that covers where required are properly installed on all equipment. Provide all covers, padding, guards, etc. as required to guard any equipment against damage.

Return all damaged equipment to the supplier for total corrective repairs. If deemed necessary by the Contract Administrator, the damaged equipment shall be replaced with new product.

1.3 SITE

.1 Classification of Plant Areas

.1 Ordinary

1.4 DOCUMENTATION

.1 Submittals

.1 Submit Shop Drawings for all products supplied by this Division.

.2 Shop Drawings for City supplied equipment will be provided to the Contractor

.2 Construction Record Drawings

.1 Maintain on-site a complete set of Construction Record Drawings as listed in Division 1 of this Specification.

.2 In addition to the requirements as stated in Division 1, record the following information on the Drawings:

.1 All changes, alterations or additions;

.2 All instrumentation cable and control tubing; and,

.3 All changes to the numbers and location of outlets, motors, panels and end devices that may occur during the course of the Work.

.3 Before requesting the Certificate of Total Performance, make any necessary final corrections to the Drawings, sign each print as a certification of accuracy and deliver all sets to the Contract Administrator for approval.

Part 2 Products

2.1 GENERAL

.1 Refer to the requirements of Division 1.

.2 Selected Products:

.1 Products shall be in compliance with the Contractor Supplied Standardized Goods as outlined in Section E9, E10, and E11.

.2 Provide products and materials that are new and free from all defects.

.3 The design has been based on the use of the first named product where multiple products have been listed.

.3 Quality of Products

.1 All products provided to be CSA and ULC approved where applicable.

.2 If products specified are not CSA approved, obtain approval of the relevant provincial regulatory authority. Pay all applicable charges levied and make all modifications required for approval.

.3 Refer to Division 1 of this Specification for further information.

.4 Uniformity of Manufacture

.1 Unless otherwise specifically called for in the Specification, uniformity of manufacture to be maintained for similar products throughout the Work.

.5 Use of Products during Construction

.1 Any equipment used for temporary or construction purposes is to be approved by the Contract Administrator. Clean and restore to "as new" condition all equipment prior to the time of Substantial Performance.

2.2 INSTRUMENTATION

.1 General

.1 Instruments and installation methods to be suitable for the environmental conditions in which they are to be installed.

.2 Determine where injurious conditions may be expected to occur and make proper provision to protect the instruments to ensure their proper and reliable operation.

2.3 IDENTIFICATION

.1 Refer to City of Winnipeg Water and Waste Department – Identification Standard, Rev 00 for general identification requirements.

.2 Provide 3 mm thick lamicoid nameplates with 6 mm black lettering on white background. Identify the loop tag number (where applicable) and the device name, function, and instrument range or setpoint value on the nameplate.

.3 Where it is not possible to attach a lamicoid nameplate to a field instrument component, provide the component with a stainless steel metal tag firmly wired to the device and identified with the loop tag number.

.4 Identify all wires where they terminate at the marshalling panels, junction boxes and field devices with a heat shrink sleeve with machine printed labeling.

.5 Clearly mark all panels, pull boxes, junction boxes, etc. to indicate the nature of service.

.6 Provide neatly typed circuit directories for panel power distribution systems to indicate loops or devices powered by the circuit and the fuse size.

.7 Identify all exposed control conduits at all pull box locations, where the conduits enter or leave a room, and 13 m on centre throughout the room. This shall apply to conduits above removable ceilings. Use Thomas & Betts TY-RAP 5532-M labels conduit identification.

.8 For direct current wiring use black for positive and white for negative.

.9 For thermistor wiring to motors use red and blue coloured, insulated wire.

Part 3 Execution

3.1 SITE EXAMINATION

.1 Refer to the requirements of Division 1.

.2 No additional compensation will be given for extra Work due to existing conditions that a Site examination prior to Bid should have disclosed.

3.2 COORDINATION WITH OTHER DIVISIONS

.1 Examine the Drawings and Specifications of all Divisions and become fully familiar the Work. Before commencing Work, obtain a ruling from the Contract Administrator on any conflicting issues between Divisions. No compensation will be made for any costs arising from conflict not identified before Work has commenced.

.2 Coordinate the Work to be performed under this Section of the Specification with all Divisions installing equipment to ensure that there are no conflicts.

.3 Install anchors, bolts, pipe sleeves, hanger inserts, etc. required in ample time to prevent delays to other Division's installation Work.

.4 Lay out the Work and equipment with due regard to architectural, structural and mechanical features. Architectural and structural Drawings take precedence over electrical Drawings regarding locations of walls, doors, and equipment.

.5 Structural members shall not be cut without prior approval of the Contract Administrator.

.6 Examine previously constructed Work and notify the Contract Administrator of any conditions, which prejudice the proper completion of this Work.

3.3 PRODUCT HANDLING

.1 Use all means necessary to protect the products included in this Division before, during and after installation, and to protect products and installed Work of all other trades.

.2 Any damage to the products and/or installed Work shall be repaired or replaced by the Contractor at no additional cost to the City and to the approval of the Contract Administrator.

.3 Remove advertising labels from all products installed that have such labels attached. Identification or CSA labels are not to be removed.

.4 Remove dirt, rubbish, grease, etc. resulting from Work performed under this Division of the Contract from all surfaces.

3.4 SEPARATION OF SERVICES

.1 Maintain separation between the electrical wiring system, piping, ductwork, and the instrumentation cables so that each system is isolated (except at approved connections to such systems) to prevent galvanic corrosion. In particular, contact between dissimilar metals, such as copper and aluminum, in damp or wet locations is unacceptable.

.2 Do not support wiring from pipes, ductwork, etc. Hangers for suspended ceilings are not to be used for the support of wiring.

.3 Classifications of Circuits

.1 The circuit categorization shall of first priority follow Canadian Electrical Code with respect to separation for electrical safety and the following shall apply with respect to electro-magnetic compatibility:

Very Noisy	High voltage circuits and their associated grounding
	High current (>200 A) LV circuits.
	Harmonic-rich LV circuits
	DC circuits: un-suppressed or above 50 V
Noisy	Low current class two (2) circuits
	Medium power pulsed or radio frequency circuits
Indifferent	ELV digital status circuits
	Intrinsically safe circuits
	Telecommunications circuits
	Fire alarm and emergency lighting circuits (note that some fire alarm circuits may fall into the category of signal circuits).
	Any other emergency, shutdown, or high integrity circuit (e.g. toxic gas alarm).
Sensitive	Analogue signal circuits
	Data communication circuits
Very Sensitive	Low level voltage and current signals (e.g. from instrument sensors).

.4 Separation of Circuits

.1 This Section relates to the running of cables carrying differing types of circuit in close proximity to one another and to other services. Sensitive circuits shall normally be run in overall shielded cable. Very sensitive circuits shall normally be run in individually twisted pair shielded cable.

.2 For cables sharing the same support/containment system, the following shall provide guidance to minimize extraneous interference:

Segregation between circuits	Very Noisy	Noisy	Indifferent	Sensitive	Very Sensitive
Very Noisy	Thermal grouping as per CE Code	150 mm	300 mm	300 mm	300 mm
Noisy	150 mm	Thermal grouping as per CE Code	150 mm	150 mm	150 mm
Indifferent	300 mm	150 mm	Separation of circuit types.	100 mm	100 mm
Sensitive	300 mm	150 mm	100 mm	Touching	50 mm
Very Sensitive	300 mm	150 mm	100 mm	50 mm	Touching

3.5 WIRE AND CABLE

.1 Refer Division 26.

3.6 CONTROL WIRING COLOUR IDENTIFICATION

.1 Colour Codes

Conductor Purpose	Colour
Power, 120/208/240 VAC Supply	Black
Power, 120/208/240 VAC Neutral	White
Power, 24 VDC Supply (+)	Blue
Power, 24 VDC Common (-, or 0VDC)	Brown
Discrete Control AC	Red
Discrete Control DC	Blue
Intrinsically Safe	IS (light) Blue
Protective Earth (PE)	Green
Signal Ground/Instrumentation Earth (IE)	Green/Yellow

3.7 NETWORK CABLE – JACKET COLOUR

.1 Colour Codes

Cable Purpose	Colour
Ethernet, CAT5E or CAT6	Blue
Profibus DP	Purple
Profibus PA, Non-Intrinsically Safe	Black
Profibus PA, Intrinsically Safe	Light Blue
Modbus/RTU (serial)	Grey

3.8 EQUIPMENT CONNECTIONS

.1 Prior to the connection of signal wiring to process control and instrumentation devices, check the device voltage rating and polarity for compatibility with the corresponding loop and/or schematic diagram. Where device and circuit characteristics are found to be incompatible, the connections are not to be made. Report the condition immediately to the Contract Administrator.

.2 All control wiring diagrams illustrate typical control circuits applicable to the type of equipment specified. Control circuits may vary with different manufacturer's equipment. Verify all control circuits with the manufacturers of the equipment and make any corrections to the control wiring diagrams that may be required.

3.9 WIRING TO EQUIPMENT SUPPLIED BY OTHER DIVISIONS

.1 Equipment supplied by the City or by other Divisions, that have external or field mounted control devices, are to be installed, wired and commissioned by this Division.

3.10 INSTRUMENT MOUNTING STANDS

.1 Supply and install instrumentation mounting stands as required. Stands are to be either floor or wall mounted. The mounting stands are to be fabricated from aluminum.

.2 Supply and install protective drip shields for any exterior stand-mounted instrumentation equipment. Drip shields are to extend 50 mm past the front and side faces of the equipment. Drip shields are to be fabricated from aluminum.

3.11 SEALING OF WALL AND FLOOR OPENINGS

.1 Seal all conduit and cable entries passing through walls of buildings, through partition walls separating electrical rooms from other areas, through fire separations, and through floors above grade.

.2 Seal openings after all wiring entries have been completed.

.3 Sealing material shall be fire resistant and shall not contain any compounds that could chemically affect the wiring jacket or insulating material. Cable penetrations through fire separations, if required, are to be sealed. Submit shop drawing for rated assembly prior to installation of fire stop.

3.12 TAGGING STANDARDS FOR DEVICES AND WIRING

.1 Tag all devices, wires, and I/O using the assigned loop, equipment, or device tag name. Where tag naming and numbering is not specified, the Contract Administrator will provide naming and numbering that is consistent with the plant naming conventions.

3.13 TESTING OF INSTRUMENTATION LOOPS

.1 After all devices within a loop have been connected, check the loop for correct functioning and interaction with other loops, where applicable. Provide written notice to the Contract Administrator when the loops are going to be tested so that the tests may be witnessed at the Contract Administrator’s discretion.

.2 Check the operation of final control elements such as solenoid valves, actuators, etc. by manual control before checking with automatic control.

.3 Check and simulate all alarms and shutdown functions.

.4 Test all tubing for leaks in compliance with ISA RP7.1. Isolate all instruments when tubing is being tested to protect against over pressure.

.5 Perform tests and record results on the test data forms that are included in this Section. Develop additional and/or more detailed test forms as necessary to suit more complex instrumentation.

.6 Sign and date all test reports. Submit the test reports to the Contract Administrator within five Business Days of testing.

.7 Coordinate and cooperate with City’s staff while they verify the instrument loop I/O in the programmable logic controller (PLC) and on the supervisory control and data acquisition (SCADA) system.

3.14 CALIBRATION

.1 Instruments are to be factory pre-calibrated. Verify calibration after installation for all instruments installed under these Specifications. Provide a printed record of the factory calibration parameters for "smart" devices.

.2 Prior to calibration, completely program all "smart" transmitters including entries of the appropriate range and tag number. Provide a printed record of smart device serial numbers against their assigned tag number with all programmed parameters.

.3 Calibrate all instruments to an accuracy of 0.5 percent of full range, or to the manufacturer's stated accuracy of the instrument whenever an accuracy of 0.5 percent is not achievable.

.4 Prior to instrument installation perform the following applicable calibration for each instrument and its associated signal conditioning equipment:

.1 Calibrate online analyzers with known samples.

3.15 COMMISSIONING

.1 Refer to the requirements of Division 1 for additional requirements.

.2 Inspections

.1 Provide two weeks' written notice to the Contract Administrator prior to energizing any system to allow for inspection by the Contract Administrator of the following:

.1 Proper mounting; and,

.2 Proper connections.

.2 During Commissioning, demonstrate to the Contract Administrator proper calibration and correct operation of instruments and gauges

.3 Commissioning of the instrumentation and control system to include but not be limited to the following.

.1 Verify installation of components, wiring connections and piping connections.

.2 Supervise wiring continuity and pipe leak tests.

.3 Verify instrument calibration and provide written report.

.4 Function check and adjust the instruments and control equipment under operational conditions.

.5 Coordinate manufacturer’s service personnel as required for complete system testing.

.6 Instruct plant personnel in correct method of instruments equipment operation.

.7 Direct plant personnel at hand-over as to final adjustment of the system for correct plant operation.

.8 Ensure that the Manufacturer’s representatives cooperate to complete the Work of this Section.

.9 Verify signal levels and wiring connections to all instrumentation and control equipment.

.10 Work with control system programmer to verify all field devices, wiring, calibration and operation.

3.16 TEST FORMS

Form No.	**Title**
.1 ITR	Instrument Test Report
.2 LCR	Loop Check Report

LOOP CHECK REPORT

□ CHECKED OUT OK
□ NOT APPLICABLE
□ FURTHER ACTION REQUIRED

	INSTRUMENT TAG NO.								
LOOP NO. _____ SHEET NO. _____ P & I DWG. NO. _____									
INSTALLATION COMPLETE									
Primary Element									
Impulse Lines									
Block and Drain Valves									
Air Supply/Filter/Reg.									
Wiring									
Tracing/Insulation/Housing									
Mounting and Location									
PLC/SCADA I/O & Status									
CALIBRATED									
Impulse Lines Press. Tested									
LOOP CHECKED									
Element To Receiver									
X Mtr. to Receiver									
X Mtr./Trans. to Receiver									
X Mtr./Trans. to Switches									
Switches to Annunciator									
Interlocking Circuit									
Controller to Valve									
Controller Action D or R									

REMARKS:

READY FOR START-UP
DATE:

_____

Installed by:

_____

Checked by:

_____

INSTRUMENT TEST REPORT

SYSTEM: _____

SERVICE: _____ TAG NO._____

LOCATION:
_____

MAKE: _____MODEL: _____

SERIAL NO.: _____CSA: _____

ELEMENT: _____ RANGE: _____

DESIGN SETTING/RANGE: _____ CONTACT TO: _____

ON: _____ SIGNAL IN:_____ OUT:_____

ASSOCIATED INSTRUMENT: _____

INSTRUMENT CONDITION: _____ CONFORM TO SPEC: _____

PROJECT NO.:_____ DATA SHEET: _____

	TEST 1				**TEST 2**			
TEST METHOD								
	INPUT		**OUTPUT**		**INPUT**		**OUTPUT**	
PROCESS	**INC.**	**DEC.**	**INC.**	**DEC.**	**INC.**	**DEC.**	**INC.**	**DEC.**
TEST POINT 1								
TEST POINT 2								
TEST POINT 3								
TEST POINT 4								
TEST POINT 5								
COMMENTS								
GRAPHS								

TESTED BY: _____ CHECKED BY: _____

DATE: _____ DATE: _____

END OF SECTION

Part 1 General

1.1 REFERENCES - GENERAL

.1 Suppliers, Equipment, Products, and Execution must meet all requirements detailed in Section 29 05 00 – Common Work Instrumentation.

.2 Local control stations shall be supplied to house local control switches, push buttons and indicator lights associated with field devices (valves, drives etc.). The control stations shall be located in close proximity to their associated devices. Where a group of devices are located within close proximity to each other, the local controls may be combined into a single common local control panel. Line of site must be maintained between all devices and the respective local controls.

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.

2.2 ENCLOSURES

.1 Provide Electrical EEMAC Type 12 enclosures for ordinary locations.

2.3 WIRING AND ACCESSORIES

.1 Provide wiring inside the enclosures 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 wire ways so that the total cross sectional area of the insulated wire and cable does not exceed 40% 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 enclosure. Identify each terminal strip with a terminal strip number, defined as follows:

.1 Wire identification to use the connected field device tag name with the wire's corresponding end device terminal number appended to it.

.2 Identify every joint and/or terminal of the above wire run with the same identifier until the wire meets another tagged device, at which point the wire identifier will change to use the new device name and terminal number.

.3 For example, pressure transmitter FIT-740 located in the field has a 1 PR-TPSH cable connected to it. The cable runs through a junction box to a marshaling panel. The wire identifiers for the pair of wires would be FIT-740 all the way to the marshaling panel.

.4 Identify spare wires by using the cable tag, wire number and an "-SP" suffix.

.5 Arrange wiring on terminal blocks such that all internal panel wiring terminates on the inboard side of the terminal blocks and all external wiring terminates on the outboard side.

.7 Provide sufficient terminals so that not more than two wires are connected under the same terminal. Provide 20% spare terminal capacity at each terminal block assembly.

.8 Terminals shall be Weidmuller W Series color coded as follows:

Red = positive 24 VDC
Black = analog signal plus
White = analog signal common and VAC neutral
Grey = 120 VAC
Green = ground

.9 Provide nameplates for each device on or within the panels and enclosures. Nameplates shall be white lamicoid with black lettering, a minimum of 25 mm x 75 mm in size with up to three lines of 5 mm lettering. Securely fasten nameplates in and situate them in a visible location.

2.4 PANEL GROUNDING

.1 Provide a ground system for the instrumentation circuits.

.2 Provide grounding lugs for each panel, suitable for termination of up to #2 AWG copper grounding conductor.

.3 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 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA-C22.2 No. 214, Communications Cables (Bi-National standard with UL 444).

.2 CSA-C22.2 No. 232, Optical Fiber Cables.

.2 Telecommunications Industry Association (TIA)/Electronic Industries Alliance (EIA)

.1 TIA/EIA-568-B.1, Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements.

.2 TIA/EIA-568-B.2, Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components.

.3 TIA/EIA-568-B.3, Optical Fiber Cabling Components Standard.

.4 TIA/EIA-606-A, Administration Standard for the Commercial Telecommunications Infrastructure.

.5 TIA TSB-140, Telecommunications Systems Bulletin - Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems.

.6 TIA-598-C], Optical Fiber Cable Color Coding.

1.2 DEFINITIONS

.1 Refer to TIA/EIA-598-C, Annex A for definitions of terms: optical-fiber interconnect, distribution, and breakout cables.

1.3 PRODUCT DATA

.1 Submit product data in accordance with Division 26.

1.4 RELATED WORK

.1 Refer to Division 26.

1.5 INSPECTION

.1 Provide adequate notice to the Contract Administrator so that all cable installations can be inspected prior to energizing equipment.

1.6 STANDARDS

.1 All wire and cable shall be CSA approved.

Part 2 Products

2.1 TWISTED PAIR SHIELDED CABLES (TPSH)

.1 TPSH shall be constructed as follows:

□

.1 Two copper conductors, stranded, minimum #18 AWG, PVC insulated, twisted in nominal intervals of 50 mm.
.2 Insulated for 600 V, 90°C.
.3 100 percent coverage aluminum foil or tape shield.
.4 Separate bare stranded copper drain wire, minimum #18 AWG.
.5 Overall flame retardant PVC jacket to CSA-C22.2.
.6 The entire cable assembly to be suitable for pulling in conduit or laying in cable tray.
.7 Interlocked aluminum armour and outer PVC jacket.
.8 Shaw Type 1751-CSA or Beldon equivalent.

.2 Where multi-conductor TPSH cables are called for, each pair shall be individually shielded, continuous number coded, and the cable assembly shall have an overall shield and overall flame retardant PVC jacket.

2.2 RTD AND MULTI CONDUCTOR SHIELDED CABLE

.1 RTD cables shall be CSA approved and shall be constructed as follows:

.1 Three or more copper conductors, stranded, minimum # 18 AWG.
.2 PVC insulated for 600 V.
.3 100 percent coverage aluminum foil or tape shield.
.4 Separate bare stranded copper drain wire.
.5 Interlocked aluminum armour and outer PVC jacket.
.6 Overall flame retardant PVC jacket to CSA-C22.2.

2.3 TECK CABLES

.1 As per Division 26.

2.4 WIRE

.1 As per Division 26.

2.5 100 BASE TX CATEGORY 6 COMMUNICATION CABLE

.1 Category 6 cable shall be CSA approved and constructed as follows:

.1 Four bonded pairs, solid stranded, #24 AWG.
.2 Interlocked aluminum armour.
.3 Rip cord.
.4 PVC inner and outer jackets.
.5 UL verified to Category 6.
.6 Insulated for 300 V.
.7 Shielded

Part 3 Execution

3.1 ANALOG SIGNALS

.1 Use TPSH cable for all low level analog signals such as 4-20 mA, pulse type circuits 24 VDC and under, and other signals of a similar nature.

□

.2 Use RTD cable for connections between RTDs and transmitters or control system RTD inputs.

3.2 DIGITAL SIGNALS

.1 Use TPSH cable for all low level input (24 V and below) and output signals to the control system.

3.3 INSTRUMENT POWER

.1 Use Teck cable or wire and conduit for power to instruments, for 120 V signals other than those mentioned above and as otherwise indicated on the Drawings. Use stranded wire and cable to supply power to instruments.

3.4 INSTALLATION

.1 Install instrumentation cables in cable trays. Use a minimum of 300 mm and a maximum of 1000 mm length of liquid tight flexible conduit to connect the field sensors to the conduit.

.2 Where instrumentation cables are installed in cable trays, provide barriers in the tray to separate instrumentation cables from power cables.

.3 At each end of the run leave sufficient cable length for termination.

.4 Do not make splices in any of the instrumentation cable runs.

.5 Cable shields shall be terminated on insulated terminals and carried through to the extent of the cable.

.6 Ground cable shields at one end only. Unless otherwise specified, ground the shields at the PLC control panel.

.7 Protect all conductors against moisture during and after installation.

3.5 CATEGORY 6 INSTALLATION:

.1 Always follow the Manufacturer's guidelines for minimum bend radius and tension.

.2 All installations and terminations shall be performed by personnel experienced in Category 6 cable installation.

.3 Perform cable testing with time domain reflectometer instrument and provide complete detailed test report. Test all runs upon completion of permanent terminations, using instrumentation acceptable to Contract Administrator. Before commencing testing, submit sample test data sheets and information with respect to test instrumentation to be used.

.1 Test for the following:

.1 Continuity.

.2 Pair placement and polarity.

.3 DC resistance.

.4 Characteristics at highest contemplated frequency:

.1 Attenuation - data cable.

.2 Mutual Capacitance - data cable.

.3 Near-end crosstalk (NEXT) - data cable.

.5 Run length.

.2 Category 6 using certified level III tester to: TIA/EIA-568-B.2.

.3 Reconnect or re-install and retest as necessary to correct excessive variations.

□

3.6 FIELD QUALITY CONTROL

.1 Test horizontal UTP cables as specified below and correct deficiencies provide record of results as hard copy.

.1 Perform tests for Permanent Link on installed cables, including spares:

.1 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.

.1 Category 6 using certified level III tester to: TIA/EIA-568-B.

3.7 CONDUCTOR TERMINATIONS

.1 All equipment supplied shall be equipped with terminal blocks to accept conductor connections.

.2 Instrumentation conductors, where terminated at equipment terminals other than clamping type terminal blocks, shall be equipped with Burndy-YAE-2 or STA-KON, self-insulated, locking type terminators, sized as required to fit conductors and screw terminals.

3.8 TESTING

.1 Test all conductors for opens, shorts, or grounds. Resistance values shall not be less than those recommended by the cable manufacturer.

3.9 IDENTIFICATION

.1 Identify all instrumentation cables.

.2 Identify each conductor with wire numbers using a machine printed Raychem TMS heat shrink wire marker or approved equal in accordance with B7.

END OF SECTION

□

Part 1 General

1.1 REFERENCES - GENERAL

.1 Equipment, Products and Execution must meet all requirements detailed in Section 29 05 00 - Common Work Instrumentation.

Part 2 Products

2.1 MISCELLANEOUS PANEL DEVICES

.1 Ethernet Switch

- .1 Eight port unmanaged Ethernet switch.
- .2 Power Supply: 24 VDC.
- .3 Mounting: DIN rail.
- .4 Approved Product: Schneider Electric Connexium TCSEU083FN0.

.2 Pilot Lights

- .1 Provide LED transformer type pilot lights for extended lamp life, oil tight, push to test, complete with appropriate colour lenses. Normal colours used are run=red, stop=green, fault=amber. Refer to Division 26 for additional information.

.3 Terminals

- .1 Provide strap screw type terminal blocks rated for 600 V.
- .2 Identify each terminal block within an enclosure with a unique machine printed terminal block number. Cabinet chassis grounding terminal blocks to be identified by the electrical ground symbol.
- .3 Connections to screw terminals to be locking fork tongue insulated crimp type wire connectors.
- .4 Terminals to be Weidmuller or approved equal in accordance with B7.
- .5 Provide a group of terminals for each of 120 VAC hot and neutral and 24 VDC positive and negative power. Distribution wiring to have a thermal magnetic circuit breaker upstream of all major blocks of loads, adequately sized to protect the connected load while not causing nuisance tripping.
- .6 Provide Weidmuller disconnect type terminal blocks for each load or loop powered from the marshalling panels.

.4 Nameplates

- .1 Refer to Section 29 05 00 - Common Work Instrumentation.

Part 3 Execution

3.1 REFERENCES - GENERAL

.1 Refer to Section 29 05 00 - Common Work Instrumentation.

END OF SECTION

□

Part 1 General

1.1 REFERENCES - GENERAL

.1 Refer to Section 29 05 00 - Common Work - Instrumentation and Controls.

Part 2 Products

2.1 POWER SUPPLY AND CONDITIONING EQUIPMENT

.1 General

.1 Provide all DC power supplies as required for all instrument circuits. All circuits are to be powered from the PLC control panels. Power supplies to be Hammond, G.F.C., Weidmuller or approved equal in accordance with B7, complete with an over-voltage protection module.

.2 DC power supplies shall be fully redundant. Individual fault signals from each power supply shall be monitored by the PLC for alarming.

.3 Unless otherwise required, all DC power supplies to be rated 28 VDC, adjustable plus or minus 5%, and set to provide 26.4 V on the panel direct current bus. Size the power supply for two times the connected load, minimum size is 2 amps.

2.2 NOISE SUPPRESSION

.1 Provide TVSS units in each panel to power AC instrumentation and control (I&C) loads. Power conditioners are to be SquareD, Cutler Hammer, Leviton.

Part 3 Execution

3.1 REFERENCES - GENERAL

.1 Refer to Section 29 05 00 - Common Work – Instrumentation and Controls, Part 3.

END OF SECTION

Part 1 General

1.1 REFERENCES – GENERAL

.1 Equipment, products, and execution must meet all requirements detailed in Section 29 05 00 - Common Work - Instrumentation and Controls.

1.2 GENERAL REQUIREMENTS

.1 Supervisory Control and Data Acquisition (SCADA) System for HVAC equipment

.1 The standalone HVAC SCADA system shall consist of the two HVAC controllers for AHU-639 and AHU-651, Programmable Logic Controller (PLC) and Operator Graphic Interface (OGI).

.2 The HVAC SCADA system shall utilize an Ethernet backbone for communications between individual HVAC units, PLC processor and OGI.

.3 Contractor shall supply all software, hardware, and labour to provide a fully functional and commissioned HVAC SCADA system.

.4 Ethernet connection to the plant DCS SCADA system using Modbus TCP. DCS programming will be performed by the City.

1.3 SHOP DRAWINGS

.1 Submit Shop Drawings for all hardware and software components.

Part 2 Products

2.1 OPERATOR GRAPHIC INTERFACE (OGI)

.1 The OGI shall be a 15” colour TFT multi-touch resistive screen.

.2 Communications shall be Ethernet Modbus TCP/IP.

.3 OGI to be mounted in PLC control panel.

.4 Operating System to be “Real Time”.

.5 Provide 1 GB SD memory card.

.6 Approved product: Schneider Electric Magelis GTU series.

2.2 CONFIGURATION

.1 Provide detailed graphic screens for both AHU-M639 and AHU-M651.

.2 Display all operational variables and equipment status.

.3 Provide programming to implement full control, monitoring and alarm notification of air handling unit controllers.

.4 Coordinate with the air handling unit suppliers to develop a Modbus register mapping for the interface.

.5 No control logic shall be incorporated into the OGI. All control logic shall be in the HVAC controllers or in the PLC system.

.6 Coordinate with City to interface the control system with the City’s DSC system.

.7 Configure alarm variables to match both AHU-M639 and AHU-M651.

.8 Configure remote web page viewing capability of the OGI.

.9 Configure historical logging of all process variables onto SD memory card.

.10 Submit graphic layout screens, Modbus register maps, and variable declarations as shop drawings.

Part 3 Execution

3.1 INSTALLATION

.1 Configure IP address provided by the City.

.2 Verify all communications.

.3 Provide startup and commissioning services.

.4 Coordinate verification checks with others.

.5 Provide demonstration and training to City's personnel as per Section 01 79 00.

END OF SECTION

Part 1 General

1.1 REFERENCES - GENERAL

.1 Refer to Section 29 05 00 Common Work Instrumentation.

1.2 PLC I/O INDEX

.1 The following spreadsheet gives an itemized list of the new Programmable Logic Control (PLC) System inputs and outputs. It is intended to serve as an aid for determining the cabling requirements for the Work specified in this Division.

Part 2 Products

.1 Not used

Part 3 Execution

.1 Not used

END OF SECTION

PLC I/O INDEX

			DESCRIPTION			I/O SPECIFICATION										
RECORD NO.	REV. N0.	TAG NAME	FUNCTION	SERVICE	P&ID DRAWING	ENG. UNITS	SCALE LOW	SCALE HIGH	ALARMS LOW	ALARMS HIGH	PLC CABINET	I/O TYPE	I/O ADDRESS	I/O RACK	I/O CARD SLOT	I/O POINT
0001	0		Spare								CP-M801	DI		0	2	0
0002	0		Spare								CP-M801	DI		0	2	1
0003	0		Spare								CP-M801	DI		0	2	2
0004	0		Spare								CP-M801	DI		0	2	3
0005	0		Spare								CP-M801	DI		0	2	4
0006	0		Spare								CP-M801	DI		0	2	5
0007	0		Spare								CP-M801	DI		0	2	6
0008	0		Spare								CP-M801	DI		0	2	7
0009	0		Spare								CP-M801	DI		0	2	8
0010	0		Spare								CP-M801	DI		0	2	9
0011	0		Spare								CP-M801	DI		0	2	10
0012	0		Spare								CP-M801	DI		0	2	11
0013	0		Spare								CP-M801	DI		0	2	12
0014	0		Spare								CP-M801	DI		0	2	13
0015	0		Spare								CP-M801	DI		0	2	14
0016	0		Spare								CP-M801	DI		0	2	15
0017	0		Spare								CP-M801	DO		0	3	0
0018	0		Spare								CP-M801	DO		0	3	1
0019	0		Spare								CP-M801	DO		0	3	2
0020	0		Spare								CP-M801	DO		0	3	3
0021	0		Spare								CP-M801	DO		0	3	4
0022	0		Spare								CP-M801	DO		0	3	5
0023	0		Spare								CP-M801	DO		0	3	6
0024	0		Spare								CP-M801	DO		0	3	7
0025	0		Spare								CP-M801	DO		0	3	8
0026	0		Spare								CP-M801	DO		0	3	9
0027	0		Spare								CP-M801	DO		0	3	10
0028	0		Spare								CP-M801	DO		0	3	11
0029	0		Spare								CP-M801	DO		0	3	12
0030	0		Spare								CP-M801	DO		0	3	13
0031	0		Spare								CP-M801	DO		0	3	14
0032	0		Spare								CP-M801	DO		0	3	15
0033	0	TI-M639-3	SPACE TEMPERATURE	ROOM #104 WASTEWATER LAB		°C	0	50			CP-M801	AI		0	4	0
0034	0	TI-M639-4	SPACE TEMPERATURE	ROOM #109 WATER LAB		°C	0	50			CP-M801	AI		0	4	1
0035	0		Spare								CP-M801	AI		0	4	2
0036	0		Spare								CP-M801	AI		0	4	3
0037	0		Spare								CP-M801	AI		0	5	0
0038	0		Spare								CP-M801	AI		0	5	1
0039	0		Spare								CP-M801	AI		0	5	2
0040	0		Spare								CP-M801	AI		0	5	3
0041	0		Spare								CP-M801	AO		0	6	0
0042	0		Spare								CP-M801	AO		0	6	1
0043	0		Spare								CP-M801	AO		0	6	2
0044	0		Spare								CP-M801	AO		0	6	3

Part 1 General

1.1 REFERENCES - GENERAL

.1 Refer to Section 29 05 00 - Common Work Instrumentation.

1.2 INSTRUMENT INDEX

.1 The following spreadsheet gives an itemized list of the instrumentation included as part of this Work.

Part 2 Products

.1 Not used

Part 3 Execution

.1 Not used

END OF SECTION

INSTRUMENTATION INDEX

RECORD NO.	REV. No.	LOOP NUM.	TAG NAME	DESCRIPTION		POWER SUPPLY	CALIBRATED RANGE	MOUNTING	SUPPLIED BY	INSTALLED BY	COMMENTS	SPEC. DATA SHEET	P&ID DRAWING
				INSTRUMENT TYPE	SERVICE								
0001	0	639-3	TIT-M639-3	Temperature Transmitter	ROOM #104 WASTEWATER LAB	Loop Powered	0 - 50 °C	Wall	Contractor	Contractor		I-101	P-1
0002	0	639-4	TIT-M639-4	Temperature Transmitter	ROOM #109 WATER LAB	Loop Powered	0 - 50 °C	Wall	Contractor	Contractor		I-101	P-1

Part 1 General

1.1 GENERAL REQUIREMENTS

.1 Supply and install Programmable Logic Controller (PLC) control panel for HVAC SCADA system consisting of two HVAC controllers for AHU-639 and AHU-651, PLC and Operator Graphic Interface (OGI).

.2 Supply and install Modbus TCP connection to DCS system.

.3 DCS system programming will be performed by the City.

.4 Coordinate and cooperate with other Contractors, suppliers, and the City's Representatives during system programming, start-up, and commissioning of the complete HVAC SCADA system, PLC, and associated field devices and wiring.

.5 Provide complete PLC and operator graphic interface programming, start-up and commissioning.

Part 2 Products

2.1 PROGRAMMABLE LOGIC CONTROLLERS

.1 General

- .1 Wall mounted NEMA 12 enclosure.
- .2 Cable entry via top.
- .3 Terminate all field wiring on terminal blocks in PLC panels.
- .4 Provide fused terminal blocks for all field power sourced from the control panel.

.2 PLC Processor

- .1 Programming Port: Ethernet, USB.
- .2 Device Port: Ethernet.
- .3 Program Memory: 4 MB RAM.
- .4 Approved Product: Schneider Electric M580 BME P58 1020.

.3 PLC Rack

- .1 X80.
- .2 Eight 8 slot, plate mounting.
- .3 Approved Product: Schneider Electric BME XBP 0400.

.4 PLC Power Supply

- .1 120 VAC.
- .2 Approved Product: Schneider Electric BMX CPS 2000.

.5 PLC I/O Hardware

- .1 Discrete Input:
  - .1 120 VAC.
  - .2 16 channel.
  - .3 BMX DAI 1604.
- .2 Discrete Output:
  - .1 120 VAC.
  - .2 Relay.

.3 16 channel, 2 groups.
.4 BMX DRA 1605.

.3 Analog Input:
.1 4-20mA.
.2 Fully isolated.
.3 4 channel.
.4 BMX AMI 0410.

.4 Analog Output:
.1 4-20mA.
.2 Fully isolated.
.3 4 channel.
.4 BMX AMO 0410.

.6 Power Supply

.1 Panel shall contain a 10 amp 24VDC power supply.
.2 Panel shall accept a single 120VAC, 15amp circuit.
.3 Panel door shall have a Green “Power On” light.

2.2 SPARE PARTS

.1 Provide the following spare parts for the PLC:

.1 PLC processor: M580 BME P58 1020
.2 X80, eight slot backplane: BME XBP 0400
.3 Power supply: BMX CPS 2000

2.3 PROGRAMMING

.1 Document all programming logic.

.2 Provide all programming required to interface with the air handling units HVAC controller. All control, monitoring and alarm functionality shall be replicated on the PLC control system.

.3 Coordinate Modbus register mapping with the air handling unit suppliers.

.4 Coordinate connection to the City’s DCS system with City personnel.

.5 Provide the PLC programs and the operator interface program to the City after the completion of the commissioning.

Part 3 Execution

3.1 INSTALLATION

.1 Install the hardware in accordance with the foregoing requirements to satisfy the performance requirements defined in this and other Divisions of the Specification.

.2 Cooperate with other contractors, suppliers, the City and the Contract Administrator to commission and start-up the system as defined herein.

END OF SECTION

Part 1 General

1.1 REFERENCES - GENERAL

.1 The Work includes the provision of all instrument specification sheets.

.2 Refer to Section 29 05 00.

1.2 INSTRUMENT SPECIFICATION SHEETS

.1 Provide data sheets to itemize detailed as-built information regarding the Specification of instruments included as part of this Work for each instrument supplied. The data sheets already included in this Section list specific minimum requirements for particular applications.

.2 Use forms in accordance with the ISA Standard S20 as a template for the preparation of the specification sheets.

Part 2 Products

.1 Refer to the following specification sheets.

INSTRUMENT SPECIFICATION NUMBER:	**I-101**
DEVICE:	Temperature
TAG:	Refer to Instrument Index, Section 29 40 21
SERVICE:	Space temperature
SPAN:	0 to 50°C
SENSOR:	3 wire RTD, PT 100
SENSOR LENGTH:	25 mm
SENSOR MATERIAL:	316 stainless steel
INACCURACY:	±0.1% of span
OUTPUT:	4 to 20 mA DC into 500 OHM
COMMUNICATION:	HART
POWER SUPPLY:	Loop powered 24 VDC
CONSTRUCTION:	Stainless steel wetted parts
ELECTRONIC ENCLOSURE:	Die-cast aluminum
LOCAL DISPLAY:	Head mounted LCD Display
ACCESSORIES:	Stainless steel mounting bracket
MANUFACTURER AND MODEL:	Siemens Sitrans TF

END OF SECTION