Mohawk College
G-Wing Cooling Tower Replacement

ISSUED FOR BID
MECHANICAL AND ELECTRICAL SPECIFICATIONS

Prepared For:
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DR KEY:

A = ARCHITECTURAL	S = STRUCTURAL	M = MECHANICAL
E = ELECTRICAL	LC = LEED CONSULTANT	EC = ENERGY CONSULTANT
C = CIVIL	L = LANDSCAPE CONSULTANT	O = OWNER

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

.1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

.1 This Section specifies requirements and instructions that are common to mechanical work Sections of the Specification and it is a supplement to each Section and is to be read accordingly.

1.3 DEFINITIONS

.1 Refer to Section 01 42 16, Definitions. The following are definitions of words found in mechanical work Sections of the Specification and on associated drawings:

.1 "concealed" – means work hidden from normal sight in furred spaces, shafts, tunnels, ceiling spaces, walls and partitions

.2 "exposed" – means work normally visible, including work in equipment rooms and similar spaces

.3 "provide" (and tenses of provide) – means supply and install complete

.4 "install" (and tenses of install) – means install and connect complete

.5 "supply" – means supply only

.6 "finished area" - means any area or part of an area which receives a finish such as paint, or is factory finished

.7 "governing authority" and/or "regulatory authority" and/or "Municipal authority" – means all government departments, agencies, standards, rules and regulations that apply to and govern the mechanical work and to which the work must adhere

.8 "Consultant" – means the Architect or Consulting Engineer who has prepared the Contract Documents on behalf of the Owner

.9 “Equal to” – if products supplied by an “Equal to” manufacturer are proposed for use the “Equal to” product must be equivalent in quality, size and weight, performance, and operating characteristics (including energy efficiency), to the specified product, and acceptance or rejection of an “Equal to” product will be made by the Consultant

.2 Wherever the words "indicated", "shown", "noted", "listed", or similar words or phrases are used in the specification they are understood, unless otherwise defined, to mean that the product referred to is "indicated", "shown", "listed", or "noted" on the drawings.

.3 Wherever the words "approved", "satisfactory", "as directed", "submit", "permitted", "inspected" or similar words or phrases are used in the specification or on the drawings they are understood, unless otherwise defined, to mean that work or product referred to is "approved by", "inspected by", etc., the Consultant.

.4 In the mechanical specification, singular may be read as plural, and vice-versa.

1.4 SUBMITTALS

.1 Refer to Section 01 78 39, Project Record Documents. As specified in this Section, submit the following to the Consultant:

.1 project close-out documentation: O & M Manuals, record as-built drawings, and all associated data

.2 progress payment breakdown: a detailed breakdown of the mechanical work cost

.3 Extended Warranties: copies of all extended warranties specified, dated, signed, and in the name of the Owner

1.5 JOURNEYPERSON/APPRENTICE TRADESMEN

.1 All mechanical work is to be done by tradesmen who perform only the work that their certificates permit. Apprentice tradesmen must work under direct on-site supervision of an experienced journeyperson tradesperson. C of Q required for all workers present on site and must be submitted as part of the tender package.

.2 Unless otherwise specified, the journeyperson/apprentice ratio is to be in accordance with governing regulations.

1.6 CODES, REGULATIONS, AND STANDARDS

.1 All Codes, Regulations, and Standards referred to in this Section and in Sections to which this Section applies are the latest edition of the Codes, Regulations, and Standards in effect at the time the building permit is obtained, or at the time of bid closing for the Project, whichever comes first.

.2 All work is to be in accordance with requirements with Codes, Regulations, and Standards applied by governing authorities Included but not limited to the following:

1) Ontario Building (OBC)

2) Ontario Fire Code (OFC)

3) Ontario Electric Safety Code (OESC)

4) Canadian Standards Association (CSA)

5) Underwriters Laboratory Canada (ULC)

6) National Fire Prevention Association (NFPA)

.3 All mechanical piping system work, including equipment, must comply in all respects with requirements of local technical standards authorities and CSA B51, Boiler, Pressure Vessels and Pressure Piping Code. Pressure vessels and fittings defined in Clause 4.3 of CSA B51 must bear a Canadian Registration Number (CRN).

.4 Where any governing Code, Regulation, or Standard requires preparation and submission of applications, special details, or drawings for review, prepare and submit them. Pay all associated costs associated with these submittals.

.5 All electrical items associated with mechanical equipment are to be certified and bear the stamp or seal of a recognized testing agency such as CSA, UL, ULC, or ETL, or bear a stamp to indicate special electrical utility approval.

.6 Requirements of the Contract Documents are to take precedence when they are more stringent than codes, ordinances, standards, and statutes.

1.7 IMPERIAL AND METRIC MEASUREMENTS

.1 Conform to requirements of CAN/CSA-Z234.1, Canadian Metric Practice Guide.

.2 Both Metric and Imperial units of measurement are indicated in the mechanical Specification. Metric measurements are "soft" and have been rounded off.

1.8 EXAMINATION OF SITE AND DOCUMENTS

.1 When estimating the cost of the work and prior to submitting a bid for the work, carefully examine all of the bid documents and visit the site to determine and review all existing site conditions that will or may affect the work, and include for all such conditions in the bid price.

1.9 DRAWINGS AND SPECIFICATION

.1 The mechanical drawings are performance drawings, diagrammatic, and show approximate locations of equipment and connecting services. Any information regarding accurate measurement of the building are to be taken at the site.

.2 The mechanical drawings are intended to convey the scope of work and do not show architectural and structural details. Provide, at your cost, all offsets, fittings, transformations, and similar products required as a result of obstructions and other architectural and structural details but not shown on the drawings.

.3 The locations of equipment and materials shown may be altered, when reviewed by the Consultant, to meet requirements of the equipment and/or materials, other equipment or systems being installed, and of the building, all at your cost.

.4 The mechanical drawings and specification are intended to be cooperative. Perform all work that is shown, specified, or reasonably implied on the drawings but not mentioned in the specification, or vice-versa, as though fully covered by both.

.5 When the scale and date of the drawings are the same, or when the discrepancy exists within the specification, the costliest arrangement will take precedence.

.1 the specification

.2 drawings of larger scale

.3 drawings of smaller scale

.4 drawings of later date when the scale of the drawings is the same

.6 In the case of discrepancies between the drawings and specifications, the documents will govern in the order specified in the General Conditions, however, when the scale and date of the drawings are the same, or where the discrepancy exists within the specification, the costliest arrangement will take precedence.

1.10 PLANNING AND LAYOUT OF THE WORK, AND ASSOCIATED DRAWINGS

.1 Properly plan, coordinate, and establish the locations and routing of services with all trades affected prior to installation such that the services will clear each other as well as any obstructions, including structural components of the building. Unless otherwise specified, the order of right-of-way for services is to be as follows:

.1 piping requiring uniform pitch

.2 piping 100 mm (4") diameter and larger

.3 large ducts (main runs)

.4 electrical cable tray and bus duct

.5 conduit 100 mm (4") diameter and larger

.6 piping less than 100 mm (4") diameter

.7 smaller branch ductwork

.8 conduit less than 100 mm (4") diameter

.2 Unless otherwise shown or specified, conceal all work in finished areas, and conceal work in partially finished or unfinished areas to the extent made possible by the area construction. Install piping, ductwork, and similar services as high as possible to conserve headroom and/or ceiling space. Notify the Consultant where headroom or ceiling space appears to be inadequate, prior to installation of the work.

.3 Locate all shut-off valves, balancing devices, air vents, equipment, and similar products, particularly such products located above suspended ceilings, for easy access for servicing and/or removal.

.4 Layout Drawings: Prepare layout drawings for mechanical work with locations of equipment and routing of services generally in accordance with the Contract Documents. Confirm inverts, coordinate with and make allowances for the work of other trades, accurately layout the work, and be entirely responsible for all work installed in accordance with layout drawings. Where any invert, grade, or size is at variance with the Contract Documents, notify the Consultant prior to proceeding with the work.

.5 Interference Drawings: Prepare dimensioned working interference drawings, supplementary to the Contract Documents, for all areas where multiple services and/or equipment occur, or where the work due to architectural and structural considerations requires special study and treatment. Review interference drawings with the Consultant before the work is installed. Where your work has been installed in such areas without preparation of interference drawings and conflicts occur, revise your work to suit at no additional cost.

1.11 GENERAL RE: INSTALLATION OF EQUIPMENT

.1 Unless otherwise specified or indicated, install all equipment in accordance with the equipment manufacturer’s recommendations and instructions. Governing Codes, Standards, and Regulations take precedence over manufacturer’s instructions.

1.12 PERMITS AND FEES

.1 Apply for, obtain and pay for all permits required to complete the mechanical work.

1.13 WORKPLACE SAFETY

.1 Comply with requirements of the Workplace Hazardous Materials Information System (WHMIS) regarding the use, handling, storage and disposal of hazardous materials. Submit WHMIS MSDS (Material Safety Data Sheets) for all products where required, and maintain 1 copy at the site in a visible and accessible location available to all personnel.

.2 Comply with all requirements of Occupational Health and Safety Regulations and all other regulations pertaining to health and safety, including worker’s compensation/insurance board and fall protection regulations.

.3 If at any time during the course of the work asbestos containing materials, black mould, lead paint, or any other such materials are encountered or suspected, and not previously identified, immediately report the discovery to the Consultant and cease all work in the area in question. Do not resume work in affected areas until the situation has been properly corrected and without written approval from the Owner.

1.14 SHOP DRAWINGS AND PRODUCT DATA SHEETS

.1 Submittals under all Division 20 shall be in accordance with General Conditions and Section 01 33 00.

.2 Submit for review, shop drawings and/or product data sheets indicating in detail the design, construction, and performance of products as requested in Sections of this Specification. The number of copies of shop drawings and/or product data sheets will be as later directed.

.3 Shop drawings are those prepared specifically for the Project. Product data sheets are copies of manufacturer's standard catalogue, etc., literature.

.4 Endorse each copy of each shop drawing or product data sheet "Correct for Review By Consultant", or "Certified to Be In Accordance With All Requirements" and include your company name, the submittal date, and the signature of an officer of your company to indicate your review and approval. Shop drawings are required to have approval stamp from, constructor, consultant and Mohawk College. 1 stamp indicating non conformance will trigger rejection of the drawings. Equipment ordered before full shop drawing approval we be returned or exchanged at contractor expense.

.5 "This review is for the sole purpose of ascertaining conformance with the general design concept. This review does not approve the detail design inherent in the shop drawings, responsibility for which remains with the Contractor, and such review does not relieve the Contractor of the responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents. Be responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation, and for coordination of the work of all sub-trades."

1.15 CHANGES OR REVISIONS TO THE WORK

.1 Whenever the Consultant proposes in writing to make a change or revision to the design, arrangement, quantity, or type of any work from that required by the Contract, prepare and submit to the Consultant for approval, a quotation being your proposed cost for executing the change or revision inclusive of all labour and material debit and credits.

.2 Your quotation is to be a detailed and itemized estimate of all products, material, labour, and equipment costs associated with the change or revision, plus overhead and profit percentages and all applicable taxes and duties.

.3 Unless otherwise stated in the Contract, the following requirements apply to all quotations submitted:

.1 when the change or revision involves deleted work as well as additional work, the cost of the deleted work (less overhead and profit percentages but including taxes and duties) is to be subtracted from the cost of the additional work before overhead and profit percentages are applied to the additional work

.2 material and labour costs are not to exceed those published in local estimating price guides, less applicable trade discounts, and labour costs for journeyperson and apprentice labour must not exceed prevailing rates at the time of execution of the Contract, and must reflect the actual personnel performing the work

.3 costs for rental tools and/or equipment are not to exceed local rental costs

.4 if overhead and profit percentages are not specified in the General Conditions of the Contract, Supplementary Conditions, or elsewhere in the Specification, but allowable under the Contract, then allowable percentages for overhead and profit are to be 20% for overhead and 10% for profit

.5 the overhead percentage will be deemed to cover all quotation costs other than actual site labour, product and materials and rentals

.6 all quotations, including those for deleted work, must include a figure for any required change to the Contract time.

.4 Failure to submit a proper quotation to enable the Consultant to expeditiously process the quotation and issue a Change Order will not be grounds for any additional change to Contract time.

1.16 SCAFFOLDING, RIGGING, AND HOISTING

.1 Unless otherwise specified or directed, supply, erect and operate all scaffolding, rigging, hoisting equipment and associated hardware required for your work. Immediately remove from the site all scaffolding, rigging, and hoisting equipment when no longer required.

.2 Do not place major erection loads on any portion of the structure without approval from the Consultant.

.3 Submit for review, rigging and hoisting plans, contemplated dates, permits, equipment, safety measures, and personnel prior to hoisting operations. Any damage to Mohawk College property in anyway will be repaired or re-done at contractor expense.

1.17 PROJECT CLOSEOUT SUBMITTALS

.1 Refer to Section 01 77 00, Closeout Procedures.

.2 Prior to application for Substantial Performance, submit all required items and documentation specified, including the following:

.1 Operating and Maintenance Manuals

.2 as-built record drawings and associated data

.3 extended warranties for equipment as specified

.4 all operating test certificates, i.e. Sprinkler Test Certificate

.5 final commissioning report and TAB report

.6 identified keys for mechanical equipment and/or panels for which keys are required, and all other items required to be submitted

.7 other data or products specified

.3 Operating and Maintenance Manuals: Submit 3 hard copies of operating and maintenance manuals consolidated in hardcover 3 "D" ring binders, each binder sized to include approximately 25% spare space for future data, and identified permanently with the Project name, "MECHANICAL OPERATING AND MAINTENANCE MANUAL" wording, and the date. Manuals are to include the following:

.1 an Introduction sheet listing the Consultant’s, Contractor’s, and Subcontractor names, street addresses, telephone and fax numbers, and e-mail addresses

.2 a Table of Contents sheet, and corresponding index tab sheets

.3 a copy of each shop drawing or product data sheet, with manufacturer's/supplier's name, telephone and fax numbers, email address, and the email address for local source of parts and service

.4 pressure test reports, and certificates issued by governing authorities

.5 Operating Data: Operating data is to include:

.1 a description of each system and its controls

.2 control schematics for equipment/systems including building environmental controls

.3 if applicable, the building automation system (BAS) architecture and all required operating data. Delta controls are to be used for all Mohawk College controls and Ainsworth shall be coordinated with for all controls and BAS work.

.4 description of operation of each system at various loads together with reset schedules and seasonal variances

.5 operation instructions for each system and each component

.6 description of actions to be taken in event of emergencies and/or equipment failure

.7 valve tag schedule, and flow diagrams to indicate valve locations

.6 Maintenance Data: Maintenance data is to include:

.1 servicing maintenance, operation and trouble-shooting instructions for each item of equipment and each system

.2 schedules of tasks, frequency, tools required, and estimated task time

.3 complete parts lists with numbers

.7 Performance Data: Performance data is to include:

.1 equipment and system start-up data sheets

.2 equipment performance verification test results, and final commissioning report

.3 final testing adjusting and balancing reports

.8 Review Submittal: Assemble one copy of the O & M Manual and submit to the Consultant for review prior to Owner training and instructions, and assembling the remaining copies. Incorporate all comments into the final submission.

.9 Digital O & M Manuals: Submit 4 digital versions of the hard copy manual using the latest version of Adobe Acrobat Portable Document Format and enhanced with bookmarks, internet links, and internal document links. The digital copies are to be copied to CDR with custom labels which indicate the project name, date, the Consultant's name, and "Operating & Maintenance Manual for Mechanical Systems".

.4 Record "As-Built" Drawings and Data: As work progresses at the site, clearly mark in red in a neat and legible manner on a set of white prints of the Contract Drawings, all significant changes and deviations from the routing of services and locations of equipment shown on the Contract Drawings and resulting from the issue of Addenda, Site Instructions, Change Orders, and job conditions. Use notes marked in red as required. Maintain the white print red line as-built set at the site for the exclusive use of recording as-built conditions, keep the set up-to-date at all times, and ensure that the set is always available for periodic review. The as-built set is also to include the following:

.1 the dimensioned location of all inaccessible concealed work

.2 the locations of control devices with identification for each

.3 the location of all piping system air vents and water hammer arrestors

.4 the location and tag identification for all tagged valves

.5 for underground piping, including service entrance/exit piping, record dimensions, invert elevations, all offsets, fittings, cathodic protection and accessories if applicable, and locate dimensions from benchmarks that will be preserved after construction is complete

.6 for fire protection systems, record actual locations of equipment, sprinkler heads, and valves, drains, and test locations, and deviations of pipe routing and sizing from that shown on the drawings

.7 the location of all concealed services terminated for future extension

.5 Digital Record "As-Built" Drawings: When work on site is complete, transfer all the as-built red line information from the site as-built drawings to a recordable and identified CAD disc with CAD work of equal quality to the Contract Drawings. Obtain a CAD disc as described below.

.6 Obtaining CAD Digital Files: The mechanical drawings have been prepared on a CAD system using the latest Release of AutoCAD software. For the purpose of producing final as-built drawings, digital files of the Contract Drawings will be supplied by the Consultant for a nominal fee.

.7 Review and Submittal: Prior to inspection for Substantial Performance of the work, submit for review, the red line site as-built white prints, a CAD digital file of the as-built drawings, and a bound set of white prints (of equal quality to the Contract Drawings) made from the digital file. The Consultant will review the drawings and, if necessary, return the disc and the marked-up white prints for corrections or further revisions, in which case complete the corrective and/or revision work and resubmit the disc and white prints until they are determined to be acceptable, all prior to issue of a Certificate of Substantial Performance.

1.18 REQUIREMENTS FOR CONTRACTOR RETAINED ENGINEERS

.1 All professional engineers retained by the Contractor to perform consulting services with regard to the Contractor’s work, i.e. seismic engineer, fire protection engineer, structural engineer, are to be members in good standing with the local Association of Professional Engineers, and are to carry and pay for errors and omissions professional liability insurance in compliance with requirements of the governing authorities in the locale of the work.

.2 The Contractor’s engineer’s professional liability insurance is to protect your Consultants and Sub-Consultants, and their respective servants, agents, and employees against any loss or damage resulting from the professional services rendered by your Consultants, Sub-Consultants, and their respective servants, agents, and employees in regards to the work of this Contract.

.3 Liability insurance requirements are as follows:

.1 coverage is to be a minimum of $2,000,000.00 inclusive of any one occurrence

.2 the insurance policy is not to be cancelled or changed in any way without the insurer giving the Owner a minimum of thirty days written notice

.3 liability insurance is to be obtained from an insurer registered and licensed to underwrite such insurance in the location of the work

.4 evidence of the required liability insurance in such form as may be required is to be issued to the Owner, the Owner's Consultant, and Municipal Authorities as required prior to commencement of your Consultant's services

1.19 EXTENDED WARRANTIES

.1 All extended warranties specified in mechanical work Sections of the Specification are to be full parts and labour warranties, at the site, and in accordance with requirements of the Contract warranty, but direct and in writing from the equipment manufacturer/supplier to the Owner.

.2 Submit signed and dated copies of extended warranties which clearly state requirements specified above.

1.20 EQUIPMENT AND MATERIAL MANUFACTURER REQUIREMENTS

.1 Equipment and materials scheduled or specified on the drawings or in the Specification have been selected to establish a performance and quality standard.

.2 In most cases acceptable equipment and material manufacturers are listed for any product specified. Unless otherwise stated the bid price may be based on products supplied by any of the manufacturers named as acceptable for the particular product. If acceptable manufacturers are not listed for a particular product, base the bid price on the products supplied by the specified manufacturers.

.3 If products supplied by a manufacturer named as acceptable are used in lieu of the products specified by manufacturer's name and model number, ensure that the product is equivalent in performance and operating characteristics (including energy efficiency if applicable) to the specified product. Pay for any additional costs and changes to associated or adjacent work resulting from the use of products supplied by a manufacturer other than the specified manufacturer. In addition, in equipment spaces where products named as acceptable are used in lieu of the specified products and the dimensions of such products differ from the specified products prepare and submit for review, if requested, accurately dimensioned layouts of the rooms affected to prove that all the equipment in the room will fit properly.

1.21 EQUIPMENT AND SYSTEM MANUFACTURER'S CERTIFICATION

.1 When equipment/system installation is complete, but prior to start-up procedures, arrange and pay for the equipment/system manufacturer's authorized representative to visit the site to examine the installation, and when any required corrective measures have been made, to certify in writing to the Consultant that the equipment/system installation is complete and in accordance with the equipment/system manufacturer's instructions.

1.22 EQUIPMENT AND SYSTEM START-UP

.1 When installation of equipment/systems is complete, but prior to commissioning, perform start-up for equipment/systems as specified in mechanical work Sections in accordance with the following requirements:

.2 submit a copy of each equipment/system manufacturer's blank start-up report sheet to the Consultant for review, and incorporate any comments

.3 under direct on-site supervision and involvement of the equipment/system manufacturer's representative, start-up the equipment/systems, make any required adjustments, document the procedures, leave the equipment/systems in proper operating condition, and submit a complete set of start-up documentation sheets signed by the manufacturer/supplier and the Contractor

1.23 EQUIPMENT AND SYSTEM COMMISSIONING

.1 After successful start-up and prior to Substantial Performance, commission the mechanical work in accordance with requirements of CSA Z320, Building Commissioning. Use commissioning sheets included with the CSA Standard, and any supplemental commissioning sheets required. Submit final commissioning data sheets, TAB reports, project closeout documents, and other required submittals.

1.24 EQUIPMENT AND SYSTEM O & M DEMONSTRATION & TRAINING

.1 Refer to equipment and system operational and maintenance training requirements specified in Division 01.

.2 Train the Owner's designated personnel in all aspects of operation and maintenance of equipment and systems as specified in mechanical work Sections of the Specification. All demonstrations and training is to be performed by qualified technicians employed by the equipment/system manufacturer/supplier. The number of hours of training and the number of Owner's personnel to be involved will be specified in the mechanical work Sections to which this Section applies.

.3 For each item of equipment and for each system for which training is specified, prepare training modules as specified below. Operating and Maintenance Manuals are to be used during the training sessions, and training modules are to include:

.1 Operational Requirements and Criteria: Requirements and criteria are to include but not be limited to equipment function, stopping and starting, safeties, operating standards, operating characteristics, performance curves, and limitations.

.2 Troubleshooting: Troubleshooting is to include but not be limited to diagnostic instructions, test and inspection procedures.

.3 Documentation: Documentation is to include but not be limited to equipment/system warranties, and manufacturer's/supplier's parts and service facilities, telephone numbers, email addresses, and the like.

.4 Maintenance: Maintenance requirements are to include but not be limited to inspection instructions, types of cleaning agents to be used as well as cleaning methods, preventive maintenance procedures, and use of any special tools.

.5 Repairs: Repair requirements are to include but not be limited to diagnostic instructions, disassembly, component removal and repair instructions, instructions for identifying parts and components, and review of any spare parts inventory.

.4 Assemble the training modules into a training manual and submit a copy to the Consultant for review prior to scheduling training. Ensure that each participant in each training session has all required training material.

.5 Schedule demonstrations and training at mutually agreed to times with a minimum of 7 working days notice.

.6 Training Session DVD: For equipment/system demonstration and training sessions as specified in mechanical work Sections, submit an identified DVD of the session prepared by a professional photographer with construction project technical training session experience.

.7 Demonstration and Training Confirmation: Obtain a list of personnel to receive demonstration and training from the Consultant, and have each participant sign the list to confirm that he/she understood the demonstration and training session.

2 PRODUCTS

NOT APPLICABLE

3 EXECUTION

NOT APPLICABLE

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

.1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

.1 This Section specifies products, common criteria and characteristics, and methods and execution that are common to one or more mechanical work Sections of the Specification, and it is intended as a supplement to each Section and is to be read accordingly.

1.3 SUBMITTALS

.1 Submittals under this Section shall be in accordance with General Conditions and Section 01 33 00 – Submittals and Division 20.

.2 Product Data:

.1 Submit product data sheets for:

.1 pressure gauges and thermometers

.2 strainers

.3 drain valves

.3 Samples:

.1 submit a sample of each proposed type of access door, and samples of materials and any other items as specified in mechanical work Sections of the Specification

.4 Access door locations: submit white prints of architectural reflected ceiling plan drawings and elevation drawings to indicate proposed access door locations in walls and ceilings in finished areas

.5 List of equipment nameplates: submit a list of equipment identification nameplates indicating proposed wording and sizes

.6 Pipe & duct identification: submit a list of pipe and duct identification colour coding and wording

.7 Valve tag chart: submit a proposed valve tag chart and a list of proposed valve tag numbering and identification wording

.8 Waste management and reduction plan: submit a waste management and reduction plan prior to commencing work and as per requirements specified in this Section

.9 Drive belts: as specified in Part 2 of this Section, submit a spare belt set, tagged and identified, for each belt driven piece of equipment

.10 Additional submittals: submit any other submittals specified in this Section or other mechanical work Sections of the Specification

2 PRODUCTS

2.1 MANUFACTURERS

.1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:

.1 Acceptable Manufacturers:

.1 As listed in materials specified in this section.

.2 Requests for substitutions shall be made in conformance with Section 01 25 00 – Substitution Procedures.

.3 Substitution Limitations:

.1 No further substitutions will be permitted.

.4 Single source responsibility: Obtain each type of piping specialty from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work. Products installed as part of the Work of this Section shall be from the same production run including all extra stock materials.

2.2 MATERIALS

.1 Firestopping And Smoke Seal Materials

.1 Firestopping and smoke seal system materials for mechanical penetrations through fire rated construction are specified in the mechanical work Section entitled Firestopping and Smoke Seal Systems and the work is to be done as part of the mechanical work.

.2 Piping Hangers And Supports

.1 General: Pipe hanger and support materials, including accessories, are to be, unless otherwise specified, in accordance with the Manufacturers Standardization Society (MSS) Standard Practice Manual SP-58, Pipe hangers and Supports-Materials, Design and Manufacture, and where possible, MSS designations are indicated with each product specified below. Conform to the following requirements:

.1 Unless otherwise specified, all ferrous hanger and support products are to be electro-galvanized.

.2 Hangers and supports for insulated piping are to be sized to fit around the insulation and the insulation jacket.

.2 Horizontal Suspended Piping: Hangers and supports are to be:

.1 Adjustable steel clevis hanger – MSS Type 1.

.2 Adjustable swivel ring band type hanger – MSS Type 10.

.3 Horizontal Pipe On Vertical Surfaces: Epoxy coated steel pipe stays are not permitted. Supports are to be:

.1 Carbon steel offset pipe clamp to support pipe away from the support surface.

.2 Heavy-duty steel pipe bracket – MSS type 26.

.3 Single steel pipe hook .

.4 Floor Supports For Vertical Risers: Supports are to be:

.1 Copper tubing riser clamp (plastic coated) – MSS Type 8.

.2 Heavy-duty steel riser clamp – MSS Type 8.

.5 Vertical Piping on Vertical Surfaces: Epoxy coated steel pipe stays are not permitted. Supports are to be:

.1 Carbon steel offset pipe clamp to support pipe away from the support surface.

.2 Heavy-duty steel pipe bracket or soil pipe bracket – MSS Type 26.

.3 Extension split pipe clamp – MSS Type 12.

.3 Piping Strainers – Duplex Basket Type

.1 Duplex basket strainers, cast bronze with flanged connections in copper piping, cast iron with threaded, flanged, or grooved connections in steel piping, each minimum ASME Class 150 1380 kPa (200 psi) rated at 65º C (150º F), and complete with:

.1 A top access stainless steel perforated basket cartridge with perforations as recommended by the manufacturer to suit the application.

.2 A drain plug for each chamber.

.3 A stainless steel flow diverter valve with diverter cartridge seals.

.4 A lever operating handle.

.4 Piping Drain Valves

.1 Minimum 2070 kPa (300 psi) water rated, 20 mm (¾") diameter, straight pattern full port bronze ball valves, each complete with a lever handle, threaded outlet suitable for coupling connection of 20 mm (¾") diameter garden hose, and a cap and chain.

.5 Pressure Gauges And Thermometers

.1 Pressure Gauges: Adjustable, glycerine filled, stainless steel,100 mm or 115 mm (4" or 4½") diameter, in accordance with requirements of ASME B40.100, Pressure Gauges and Gauge Attachments, complete with a dual scale white dial with a scale range such that the working pressure of the system is at the approximate mid-point of the scale, each accurate to within 1% of scale range, and with additional accessories/requirements as follows:

.1 A bronze ball type shut-off valve in the piping to each pressure gauge.

.2 A brass pressure snubber for each pressure gauge for piping and equipment with normal everyday flow.

.3 Wetted parts of pressure gauges in domestic water piping are to be ANSI/NSF 61 certified lead free.

.2 Thermometers: Round, adjustable, hermetically sealed stainless steel, 125 mm (5") diameter, adjustable (90°) angle bimetal dial type thermometers in accordance with requirements of ASME B40.200, Thermometers, Direct Reading and Remote Reading, each complete with:

.1 A white aluminum dual scale dial with black and blue markings and a range such that the working temperature of the system is the approximate mid-point of the scale.

.2 A suitable thermowell.

.3 For thermometers in domestic water piping, ANSI/NSF 61 lead free certification.

.6 Mechanical Work Identification Materials

.1 Equipment Nameplates: Minimum 1.6 mm (1/16") thick 2-ply laminated coloured plastic plates, minimum 12 mm x 50 mm (½" x 2") for smaller items such as damper motors and control valves, minimum 25 mm x 65 mm (1" x 2½") for equipment, and minimum 50 mm x 100 mm (2" x 4") for control panels and similar items. Additional requirements are as follows:

.1 Unless otherwise specified or required, each nameplate is to be white, complete with bevelled edges and black engraved capital letter wording to completely identify the equipment and its use with no abbreviations.

.2 Wording is generally to be as per the drawings, i.e. Fan EF-1, and is to include equipment service and building area/zone served, but must be reviewed prior to engraving.

.3 Supply stainless steel screws for securing nameplates in place.

.4 Nameplates for equipment suspended above floor level or generally not within easy viewing from floor level are to be increased in size so as to be easily readable from floor level

.2 Valve Tags: Coloured, 40 mm (1½") square, 2-ply laminated plastic with bevelled edges, red-white, green-white, yellow-black, etc., to match the piping identification colour, each complete with a 3.2 mm (1/8") diameter by 100 mm (4") long brass plated steel bead chain, and four lines of engraved maximum size identification wording, i.e.:

.1 VALVE V2

.2 100 mm (4")

.3 CHILL. WATER

.4 NORMALLY OPEN

.3 Standard Pipe Identification: Standard pipe identification is to be equal to Smillie McAdams Summerlin Ltd. or Brady vinyl plastic with indoor/outdoor type vinyl ink lettering and directional arrows, as follows:

.1 For pipe to and including 150 mm (6") diameter, coiled type snap-on markers of a length to wrap completely around the pipe or pipe insulation.

.2 For pipe larger than 150 mm (6") diameter, saddle type strap-on markers with 2 opposite identification locations and complete with nylon cable ties.

.4 Standard Pipe Identification Wording and Colours: Identification wording and colours for pipe identification materials are to be as follows:

PIPE SERVICE	IDENTIFICATION COLOUR	LEGEND
domestic cold water	green	DOM. COLD WATER
storm drainage	green	STORM
sanitary drainage	green	SAN.
plumbing vent	green	SAN. VENT

PIPE SERVICE	IDENTIFICATION COLOUR	LEGEND
condenser water supply	green	COND. WTR. SUPPLY
condenser water return	green	COND. WTR. RETURN

.5 Colours For Legends & Arrows: Colours for pipe identification legends and directional arrows are to be as follows:

IDENTIFICATION COLOUR	LEGEND & ARROW COLOUR
yellow	black
green	white
red	white

3 EXECUTION

3.1 INSTALLATION

.1 General Piping And Ductwork Installation Requirements

.1 Unless otherwise specified, locate and arrange horizontal pipes and ducts above or at the ceiling on floors on which they are shown, arranged so that under consideration of all other work in the area, the maximum ceiling height and/or usable space is maintained. If required to maintain ceiling heights, reroute and/or resize ductwork, with Consultant's approval.

.2 Unless otherwise specified, install all work concealed in finished spaces, and concealed to the degree possible in partially finished and unfinished spaces. Refer to and examine the Architectural drawings and room finish schedules to determine finished, partially finished, and unfinished areas. Note that walls which are painted are considered finished.

.3 Install all pipes and ducts parallel to building lines and to each other.

.4 Neatly group and arrange all exposed work.

.5 Service and Maintenance Access: Locate all work to permit easy access for service or maintenance as required and/or applicable. Locate all valves, dampers and any other equipment which will or may need maintenance or repairs and which are installed in accessible construction so as to be easily accessible from access doors. Where valves, dampers and similar piping or ductwork accessories occur in vertical services in shafts, pipe spaces or partitions, locate the accessories at the floor level.

.6 Dissimilar Metal Pipe Connections: Make all connections between pipes of different materials using proper approved adapters. Provide cast brass dielectric type adapters/unions at connections between ferrous and copper pipe.

.7 Cleaning: Carefully clean all ducts, pipe and fittings prior to installation. Temporarily cap or plug ends of pipe, ducts and equipment which are open and exposed during construction.

.8 Insulation Clearance: Install piping and ductwork which are to be insulated so that they have sufficient clearance to permit insulation and finish to be applied continuously and unbroken around the pipe or duct, except for ductwork at fire barriers, in which case the insulation will be terminated at each side of the duct fire damper.

.9 Surfaces To Receive Your Work: Inspect surfaces and structure prepared by other trades before performing your work. Verify that surfaces or the structure to receive your work have no defects or discrepancies which could result in poor application or cause latent defects in installation and workmanship. Report defects in writing. Installation of your work will constitute acceptance of such surfaces as being satisfactory.

.10 Piping Rust and Dirt: Any ferrous piping that exhibits in excess of 5% surface rust, either inside or outside or both is to be wire brush cleaned to bare metal and coated with suitable primer. Steel pipe, fittings and accessories are to be free of corrosion and dirt when work is complete or prior to being concealed from view. Where dirt is evident, clean the piping prior to being concealed.

.11 Repair of Finished Surfaces: For factory applied finishes, repaint or refinish all surfaces damaged during shipment and installation. The quality of the repair work is to match the original finish. This requirement also applies to galvanized finishes.

.12 Unions and Flanges: Whether shown or specified on the drawings or not, provide screwed unions or flanges in all piping connections to equipment, and in regular intervals in new piping runs in excess of 12 m (40') to permit removal of sections of piping.

.13 Elbows and Eccentric Reducers: Unless otherwise specified and except where space limitations do not permit, all piping elbows are to be long radius. Eccentric reducers are to be installed with the straight side at the top of the piping.

.14 Piping Requirements: The following requirements apply to piping designated above as high pressure piping, regardless of what may be specified to the contrary elsewhere in the Specification:

.1 Screwed fittings for steel pipe are to be Class 250.

.2 Grooved end fittings and couplings for grooved end steel pipe are to be pressure rated for the application.

.3 Solder for copper piping joints is to be 95% tin, 5% antimony.

.4 Companion flange unions are to be 300 lb. Class.

.5 Bolts and nuts for flanged joints are to be ASTM A-193, Grade B7 (bolts), and ASTM A-194, CL-2H (nuts).

.6 All other piping system accessories are to be suitable in all respects for the system operating pressure.

.7 All requirements of governing authorities are to be adhered to.

.2 Pipe Joint Requirements

.1 Do not make pipe joints in walls or slabs.

.2 Ream all piping ends prior to making joints.

.3 Screwed Steel Piping: Properly cut threads in screwed steel piping and coat male threads only with Teflon tape or paste, or an equivalent thread lubricant. After the pipe has been screwed into the fitting, valve, union, or piping accessory, not more than 2 pipe threads are to remain exposed.

.4 Welded Steel Piping: Site bevel steel pipe to be welded or supply mill bevelled pipe. Remove all scale and oxide from the bevels and leave smooth and clean. Use factory made welding tees or welding outlet fittings for piping branches off mains. Do not use shop or site fabricated fittings unless written approval has been obtained.

.5 Welding Requirements: Welding is to be TSSA registered. Welded joints are to be made by CWB certified, licensed journeyman welders qualified in accordance with CSA B51, Boiler Pressure Vessel and Pressure Piping Code, and who are in possession of a proper certificate of qualification for each procedure to be performed. Each weld is to be identified with the welder's identification symbol, and welds are not to be concealed until they have been inspected and approved. Electrodes are to be in accordance with CSA W48 Series, Electrodes, and requirements of CAN/CSA W117.2, Safety in Welding, Cutting and Allied Processes are to be followed.

.6 Flanged Joints: Unless otherwise specified, make all flanged joints with EDPM gasket materials to suit the application, and bolts and nuts. Bolts are not to be longer than the length necessary to screw the nut up flush to the end of the bolt. Bolts used for flanged connections in all piping with a working pressure of 690 kPa (100 psi) and greater are to be ASTM A-193, Grade B-7, with heavy hexagon nuts to ASTM A-194, CL-2H. Provide suitable washers between each bolt head and the flange and between each nut and the flange.

.7 Examination of Flanged Joints: A random check of bolted flanged connections will be made to verify that flanged connections are properly mated with no shear force acting on bolts. Supply all labour to disconnect and reconnect the selected flanged joints. If improperly mated joints are found, remove and reinstall the affected piping so that the flanges mate properly. If improperly mated joints are found, additional joints will be checked, and you will be responsible for the repair of any other improper joints discovered.

.8 Soldered Joints: Unless otherwise specified make all soldered joints in copper piping using flux suitable for and compatible with the type of solder being used. Clean the outside of the pipe end and the inside of the fitting, valve, or similar accessory prior to soldering. Comply with requirements of ASTM B828, Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.

.9 Mechanical Joints: Install mechanical joint fittings and couplings in accordance with the manufacturer's instructions.

.10 Grooved Pipe & Coupling Joints: Make arrangements with the coupling and fitting manufacturer for shop and/or site instructions and demonstrations as required, and adhere to the manufacturer's instructions with respect to pipe grooving, support, type of gasket required, anchoring and guiding the grooved piping system.

.11 Pressure Crimped Piping Joints: If pressure crimped couplings and fittings are used, ensure that gaskets are fully compatible with the piping fluid, and that all valves and piping accessories are suitable. Use only fitting manufacturer supplied crimping equipment. Comply with the manufacturer's latest published specification, instructions, and recommendations with respect to pipe, coupling, and fitting preparation and installation, and support, anchoring and guiding of the piping system.

.12 PVC Piping Solvent Weld Joints: Solvent weld PVC piping in 2 parts, primer stage and cementing stage, in accordance with the manufacturer's recommendations, ASTM D2855, and CSA requirements.

.13 PVC Piping Gasketed Joints: Install PVC piping with gasketed joints in accordance with the manufacturer's current published specifications, instructions and recommendations, and CSA requirements.

.3 Installation Of Waterproof Mechanical Seals

.1 Provide watertight link type mechanical seals in exterior wall openings where shown or specified.

.2 Assemble and install each mechanical seal in accordance with the manufacturer's instructions.

.3 After installation, periodically check each mechanical seal installation for leakage and, if necessary, tighten link seal bolts until the seal is completely watertight.

.4 Installation Of Fastening And Securing Hardware

.1 Provide all fastening and securing hardware required for mechanical work to maintain installations attached to the structure or to finished floors, walls and ceilings in a secure and rigid manner capable of withstanding the dead loads, live loads, superimposed dead loads, and any vibration of the installed products.

.2 Use fasteners compatible with structural requirements, finishes and types of products to be connected. Do not use materials subject to electrolytic action or corrosion where conditions are liable to cause such action.

.3 Where the floor, wall or ceiling construction is not suitable to support the loads, provide additional framing or special fasteners to ensure proper securement to the structure that is to support the products. Provide reinforcing or connecting supports where required to distribute the loading to the structural components. Submit support details for review prior to installation.

.4 Obtain written consent before using explosive actuated fastening devices. If consent is obtained, comply with requirements of CSA Standards CAN3-Z166.1 and CAN3-Z166.2.

.5 Installation Of Pipe Hangers And Supports

.6 Provide all required pipe hangers and supports.

.1 Provide any additional structural steel channels, angles, inserts, beam champs and similar accessories required for hanging or supporting pipe. Unless otherwise shown or specified, hang or support pipes from the structure only.

.2 For Insulated Pipe: Size the hanger or support to suit the diameter of the insulated pipe and install the hanger or support on the outside of the insulation and insulation finish.

.3 Underground (in earth/backfill) Piping: Support requirements for underground piping in earth/backfill) are as follows:

.4 Horizontal Above Ground Piping: Unless otherwise shown or specified, hang and/or support horizontal pipe above ground by means of hangers and/or supports specified in Part 2 of this Section. Unless otherwise shown or specified, hangers for suspended pipe to and including 25 mm (1") diameter are to be clevis type or adjustable ring type, and hangers for suspended pipe 40 mm (1½") diameter and larger are to be adjustable clevis type. Space hangers and supports in accordance with the following:

.1 Cast iron pipe: hang or support at every joint with maximum 2.4 m (8') spacing.

.2 Plastic pipe: conform to pipe manufacturer’s recommended support spacing.

.3 Copper and steel pipe: hang or support at spacing in accordance with the following schedule:

PIPE DIA.	MAX. SPACING STEEL (meters)	MAX. SPACING COPPER (meters)
to 25 mm (1")	2.4 m (8')	1.8 m (6')
40 mm (1½")	2.7 m (9')	2.4 m (8')
50 mm (2")	3.0 m (10')	2.7 m (9')
65 mm (2½")	3.6 m (12')	3.0 m (10')
75 mm (3")	3.6 m (12')	3.0 m (10')
90 mm (3½")	3.6 m (12')	3.6 m (12')
100 mm (4")	4.2 m (14')	3.6 m (12')
250 mm (10")	6.0 m (20')	
300 mm (12")	6.7 m (22')	

.4 Flexible grooved pipe/coupling joint piping: as above but with not less than 1 hanger or support between joints.

.5 Changes in direction: where pipes change direction, either horizontally or vertically, provide a hanger or support on the horizontal pipe not more than 300 mm (12") from the elbow, and where pipes drop from tee branches, support the tees in both directions not more than 50 mm (2") on each side of the tee.

.6 Grouped piping: when pipes with the same slope are grouped and a common hanger or support is used, space the hanger or support to suit the spacing requirement of the smallest pipe in the group and secure pipes in place on the common hanger or support.

.7 Roller hangers & supports: provide roller hangers or supports for all heat transfer piping 150 mm (6") diameter and larger and conveying a material 75° C (170° F) or greater to facilitate pipe movement due to expansion and contraction, and at each hanger or support tack weld a steel protection saddle to the pipe to protect the piping insulation.

.8 Inline centrifugal pumps: support piping at both sides of inline centrifugal pumps.

.5 Vertical Piping: Unless otherwise shown or specified, support vertical piping by means of supports specified in Part 2 of this Section, spaced in accordance with the following:

.1 Support vertical pipes at maximum 3 m (10’) intervals or at every floor, whichever is lesser.

.2 For sections of vertical piping with a length less than 3 m (10'), support the pipe at least once.

.3 For all vertical cast iron plain end pipe (mechanical joint type), secure the riser or pipe clamp around the pipe under a flange integral with the pipe for vertical support purposes, or provide a length of hub and spigot pipe to facilitate proper support.

.4 For all vertical steel pipe risers in excess of 3 m (10'), weld shear lugs to the pipe to carry the load.

.5 For vibration isolated piping risers, provide rubber-steel-rubber vibration isolation pads between the riser clamps and the floor.

.6 For piping subject to vertical movement exceeding 40 mm (1½") due to vertical pipe expansion, provide suitable engineered constant support hangers.

.6 Isolation for Bare Copper Tubing: Each hanger, support or securement for horizontal bare copper tubing is to be plastic coated to prevent direct contact between the pipe and the ferrous hanger. Each wall or floor clamp for vertical bare copper piping is to be isolated from the pipe by means of strips of flexible rubber inserts. The use of painted ferrous hangers and supports, including those painted with copper coloured paint, is not acceptable. Site application of tape or other types of isolation is not acceptable.

.7 Insulation Protection Shields: For insulated horizontal piping to and including 40 mm (1½") diameter, provide galvanized steel insulation protection shields between the insulation and the hanger or support. Install shields immediately after the pipe is insulated.

.8 Pipe Support from Steel Deck: Do not support piping from steel deck without written consent from the Consultant.

.7 Installation Of Pipeline Strainers

.1 Provide strainers in piping systems where shown on the drawings.

.2 Equip each strainer with a construction screen and remove after piping has been flushed and cleaned. Install permanent screens/mesh.

.3 Provide isolating valves in piping a maximum of 3 m (10') from the strainer on each side of a strainer.

.4 For "Y" shaped strainers 40 mm (1½") diameter and larger, provide blow-off piping complete with a shut-off valve with cap and chain, and terminate blow-off piping downward in a vertical position.

.5 For duplex basket strainers, equip each chamber drain plug with valved drain piping.

.8 Installation Of Equipment Drains And Piping Drain Valves

.1 Unless otherwise shown or specified, provide minimum 40 mm (1½") diameter type DWV copper drain piping from equipment overflows, condensate drain pans, pump bases, fresh air intake plenum drains, etc., to a floor drain location. Equip the drain piping with deep seal traps located in heated areas.

.2 Provide a drain valve at the bottom of piping risers, at all other piping low points, and wherever else shown and/or specified.

.3 Locate drain valves so that they are easily accessible.

.9 General Re: Installation Of Valves

.1 Generally, valve locations are indicated or specified on drawings or specified in Sections of the Specification where the valves are specified, however, regardless of locations shown or specified, the following requirements apply:

.1 Provide shut-off valves to isolate all systems, at the base of all vertical risers, in branch take-offs at mains and risers on all floors, to isolate all equipment, to permit work phasing as required, and wherever else required for proper system operation and maintenance.

.2 Install shut-off valves with handles upright or horizontal, not inverted, and located for easy access.

.3 Unless otherwise specified, provide a check valve in the discharge piping of each pump.

.4 Valve sizes are to be the same as the connecting pipe size.

.5 Valves are to be permanently identified with the size, manufacturer's name and figure number, and wherever possible, valves are to be the product of the same manufacturer.

.6 The manufacturer's name, valve model or figure number, and the pressure rating are to be clearly marked on each valve.

.7 For valves in insulated piping, the design of the valve stem, handle and operating mechanism is to be such that the insulation does not have to be cut or altered in any manner to permit valve operation.

.10 Installation Of Pressure Gauge & Thermometer Access Fittings

.1 Provide pressure gauge and thermometer access fittings in 6.4 mm (¼") threaded opening fittings for insertion/removal of piping mounted pressure gauges and thermometers. Where piping is insulated, provide extended length access fittings to accommodate the insulation.

.2 Unless pressure gauges and/or thermometers are provided with equipment, provide access fittings in the following locations:

.1 In valved tubing across the suction, suction strainer (if applicable), and discharge piping of each circulating pump.

.2 In the supply and return piping connections to main mechanical plant equipment such as boilers, chillers, heat exchangers, main coils, etc.

.3 In expansion tank(s) or piping immediately at the expansion tank.

.4 In all water connections to hot water heaters.

.5 In the downstream side of mixing valves.

.6 In separate domestic hot water storage tank(s).

.7 At the topmost outlet in each standpipe fire protection system riser.

.8 In piping at each side of a pressure reducing valve.

.9 In domestic water service piping downstream of the meter.

.10 Wherever else shown and/or specified on the drawings or in the Specification.

.2 All metal surfaces that are in contact with domestic water are to be NSF/ANSI 61 certified.

.11 Installation Of Pressure Gauges And Thermometers

.1 Pressure Gauges: Provide pressure gauges in the following locations:

.1 In valved tubing across the suction, suction strainer (if applicable), and discharge piping of each circulating pump.

.2 In the supply and return piping connections to main mechanical plant equipment such as boilers, chillers, heat exchangers, main coils, etc.

.3 In expansion tank(s) or piping immediately at the expansion tank.

.4 Wherever else shown and/or specified on the drawings or in the Specification.

.2 Thermometers: Provide thermometers in the following locations:

.1 In supply and return piping connections to main mechanical plant equipment such as boilers, chillers, cooling towers, liquid to liquid heat exchangers, main coils, etc., unless temperature indication is supplied with the equipment.

.2 In all water piping connections to hot water heaters.

.3 In the downstream side of mixing valves.

.4 Wherever else shown and/or specified herein or on the drawings.

.3 Installation Requirements: Conform to the following installation requirements:

.1 For installation of thermometers in piping wells, provide a coat of metallic base heat transfer paste or grease in the piping well.

.2 For pressure gauges in piping at equipment locations, install the pressure gauge between the equipment and the first pipe fitting.

.3 Locate, mount and adjust all instruments so they are easily readable.

.4 Where pressure gauges and/or thermometers are located at high level or in an area where they cannot be easily seen, provide remote reading instruments.

.5 All metal surfaces that are in contact with domestic water are to be NSF/ANSI 61 certified.

.12 Installation Of Equipment Drive Guards And Accessories

.1 Provide OSHA guards for all exposed accessible rotating parts such as belt drives, couplings, fan wheels, and shaft ends on all mechanical equipment.

.2 Install belt guards to allow movement of motors for adjusting belt tension.

.3 Provide a means to permit lubrication and use of test instruments with guards in place.

.4 Secure guards to the equipment or equipment base but do not bridge sound or vibration isolation.

.5 Where equipment oil level gauges, oil reservoirs, grease cups, or grease gun fittings are integral with the equipment but are not easily accessible for service, extend to an accessible location using aluminium or copper tubing.

.13 Mechanical Work Identification

.1 Identify all new/relocated mechanical work in accordance with existing identification standards at the site.

.2 Exposed Piping & Ductwork: Identify new exposed piping and ductwork as per Part 2 of this Section in locations such that it can be seen from the floor or service platforms, as follows:

.1 At every end of every piping or duct run.

.2 Adjacent to each valve, strainer, damper and similar accessory.

.3 At each piece of connecting equipment.

.4 On both sides of every pipe and duct passing through a floor, wall, or partition.

.5 At 6 m (20') intervals on pipe and duct runs exceeding 6 m (20’) in length.

.6 At least once in each room, and at least once on pipe and duct runs less than 6 m (20') in length.

.3 Concealed Piping & Ductwork: Unless otherwise specified identify new concealed piping and ductwork as per Part 2 of this Section in locations as follows:

.1 At points where pipes or ducts enter and leave rooms, shafts, pipe chases, furred spaces, and similar areas.

.2 At maximum 6 m (20') intervals on piping and ductwork above suspended accessible ceilings, and at least once in each room.

.3 At each access door location.

.4 At each piece of connected equipment, automatic valve, etc.

.4 Equipment: Provide an identification nameplate for each new piece of equipment, including items such as control valves, motorized dampers, instruments, and similar products. Secure nameplates in place, approximately at eye level if possible, with stainless steel screws unless such a practice is prohibitive, in which case use epoxy cement applied to cleaned surfaces. Locate all nameplates in the most conspicuous and readable location. Unless otherwise specified, equipment identification terminology is to be as per drawing identification.

.5 Natural And/Or Propane Gas Piping: Paint new gas piping with primer and two coats of yellow paint in accordance with Code requirements and requirements of the Painting Section in Division 09. Identify the piping at intervals as specified above.

.6 Valve Tagging & Chart: Tag valves and prepare a valve tag chart in accordance with the following requirements:

.1 Attach a valve tag to each new valve, except for valves located immediately at the equipment they control.

.2 Prepare a computer printed valve tag chart to list all tagged valves, with, for each valve, the tag number, location, valve size, piping service, and valve attitude (normally open or normally closed).

.3 If an existing valve tag chart is available at the site, valve tag numbering is to be an extension of existing numbering and the new valve tag chart is to incorporate the existing chart.

.4 Frame and glaze one copy of the chart and, unless otherwise directed, affix to a wall in each main mechanical and/or equipment room.

.5 Include a copy of the valve tag chart in each copy of the operating and maintenance instruction manuals.

.6 Hand an identified and packaged (jewel case) compact disc of the valve tag chart to the Owner at the time the O & M Manuals are submitted.

.7 Ceiling Tacks or Stickers: Where new shut-off valves, control dampers, sensors, and similar items which will or may need maintenance and/or repair are located above accessible suspended ceilings, provide round coloured ceiling tacks in the ceiling panel material, or stickers equal to Brady "Quick Dot" on the ceiling grid material to indicate locations of the items. Unless otherwise specified, ceiling tack or sticker colours are to be as follows:

.1 HVAC piping valves and equipment yellow

.2 Fire protection valves and equipment red

.3 Plumbing valves and equipment green

.4 HVAC ductwork dampers and equipment blue

.5 Control system hardware and equipment orange

.14 System Flow Diagrams

.1 Prepare AutoCAD, coloured, 1200 mm x 900 mm (48” x 36”) flow diagrams of mechanical systems to identify all equipment and valves.

.2 Install framed and glazed diagrams in equipment rooms housing the system equipment. Confirm location prior to installation.

.3 Include reduced size copies of the diagrams in each copy of the O & M Manuals.

.15 Pipe Leakage Testing

.1 Before new piping has been insulated or concealed, and before equipment, fixtures and fittings have been connected, test all piping for leakage.

.2 Tests are to be witnessed by the Consultant and/or Owner's representative, and, where required, representatives of governing authorities. Give ample notice of tests in writing and verify attendance. Have completed test report sheets dated and signed by those present to confirm proper test results.

.3 When circumstances prevent scheduled tests from taking place, give immediate and adequate notice of cancellation to all who were scheduled to attend.

Gravity Drainage & Vent Piping: Securely close all openings and pipe ends and fill piping with water up to the highest level, and ensure that the water stands at the same level for a minimum of 2 hours. After the fixtures and fittings are set and the pipes connected to the building drain or drains, turn on water into all pipe, fixtures, fittings and traps in order to detect any imperfect material or workmanship. Make a smoke test if required by the Municipality. At your option, drain and vent piping may be pressure tested with cold water at 345 kPa (50 psi) for 2 hours with zero leakage.

.4 Domestic Water Piping: Test piping with cold water at a pressure of 1½ times normal working pressure and maintain the pressure for a minimum of 2 hours.

.5 Heat Transfer (HVAC) System Piping: Test piping with cold water at a pressure of 1035 kPa (150 psi) for a minimum of 2 hours.

.6 General Re: All Testing: The following requirements apply to all testing:

.1 Ensure that all piping has been properly flushed, cleaned and is clear of foreign matter prior to pressure testing.

.2 Temporarily remove or valve off all piping system specialties or equipment which may be damaged by test pressures prior to pressure testing the systems, and flush piping to remove foreign matter.

.3 When testing is carried out below the highest level of the particular system, increase the test pressure by the hygrostatic head of 7 kPa (1 psi) for every 600 mm (24") below the high point.

.4 Include for temporary piping connections required to properly complete the tests.

.5 Piping under test pressure is to have zero pressure drop for the length of the test period.

.6 Make tight leaks found during tests while the piping is under pressure, and if this is impossible, remove and refit the piping and reapply the test until satisfactory results are obtained.

.7 Where leaks occur in threaded joints in steel piping, no caulking of these joints will be allowed under any conditions.

.8 Tests are to be done in reasonably sized sections so as to minimize the number of tests required.

.9 In addition to the leakage tests specified above, demonstrate proper flow throughout the systems including mains, connections and equipment, as well as proper venting and drainage, and Include for any necessary system adjustments to achieve the proper conditions.

.16 Supply Of Motor Starters And Accessories

.1 Motor starters for mechanical equipment, except for starters integral with packaged equipment and starters factory installed in equipment power and control panels, will be provided as part of the electrical work.

.17 Electrical Wiring Work For Mechanical Work

.1 Unless otherwise specified or indicated, the following electrical wiring work for mechanical equipment will be done as part of the electrical work:

.1 "Line" side power wiring to motor starters or disconnect switches in motor control centres and starters or disconnects on motor starter panels, and "load" side wiring from the starters or disconnects to the equipment.

.2 "Line" side power wiring to individual wall mounted starters, and "load" side wiring from the starters to the equipment.

.3 "Line" side power wiring to pre-wired power and control panels and variable frequency drives, and "load" side power wiring from the panels and VFD's to the equipment.

.4 Provision of receptacles for plug-in equipment.

.5 Provision of disconnect switches for all motors that are in excess of 10 m (30') from the starter location, or that cannot be seen from the starter location, and all associated power wiring.

.6 All motor starter interlocking in excess of 24 volts.

.7 Wiring from motor winding thermistors in motors 30 HP and larger to motor starter contacts.

.8 Provision of dedicated 120 volt, 15A-1P circuits terminated in junction boxes in mechanical equipment rooms for automatic control and building automation system wiring connections to be made as part of the automatic controls work.

.9 120 volt power connections to electrical receptacles integral with small ceiling exhaust fans, including wiring through light switches or speed controllers.

.10 120 volt wiring connections to lighting fixture/switch combinations integral with air handling units.

.11 120 volt wiring connections to duplex receptacles integral with air handling unit control panels.

.2 Mechanical wiring work not listed above or specified herein or on the drawings to be done as part of the electrical work is to be installed in conduit and is to be done as part of the mechanical work in accordance with wiring requirements specified for the electrical work.

.18 Interruption To And Shut-Down Of Mechanical Services And Systems

.1 Co-ordinate all shut-down and interruption to existing mechanical systems with the Owner.

.2 Upon award of a Contract, submit a list of anticipated shut-down times and their maximum duration.

.3 Prior to each shut-down or interruption, inform the Owner and Consultant in writing 72 hours in advance of the proposed shut-down or interruption and obtain written approval to proceed. Do not shut-down or interrupt any system or service without such written approval.

.4 Perform work associated with shut-downs and interruptions as continuous operations to minimize the shut-down time and to reinstate the systems as soon as possible, and, prior to any shut-down, ensure that all materials and labour required to complete the work for which the shut-down is required are available at the site.

.5 Pipe Freezing: Pipe freezing may be used to connect new piping to existing piping without draining the existing piping. Pipe freeze equipment is to be equal to "NORDIC FREEZE" CO^2 equipment supplied by Mag Tool Inc.

.19 Installation Of Equipment Bases And Supports

.1 Concrete Housekeeping Pads: Unless otherwise specified, shown or required, set all floor or grade mounted equipment on reinforced concrete housekeeping pads.

.2 Steel Framework Supports: Where indicated, support base mounting smaller HVAC equipment such as heat pumps, condensing units, and fan equipment on galvanized steel adjustable tubular steel framework support assemblies.

.3 Structural Steel Stands/Supports: For equipment not designed for base mounting, where required, provide welded, cleaned and prime coat painted structural steel stands or supports flange bolted to concrete housekeeping pads.

.4 Access Platforms and Miscellaneous Steel Work: Provide access platforms where shown for service access to equipment.

.20 Cutting And Patching For Mechanical Work

.1 All cutting and patching of existing building surfaces required for mechanical work, including core drilling walls and slabs for piping, will be done as part of another Division of the work and is excluded from the mechanical work.

.2 Accurately and carefully mark out the location and extent of cutting or drilling required and co-ordinate with the trade(s) performing the work. Note that the location and size of cut or drilled openings must be approved by the Consultant before the work commences, and all cut or drilled openings must not be larger than is absolutely necessary for installation of the pipe, duct, etc., and insulation where necessary.

.21 Cutting, Drilling, And Patching For Mechanical Work

.1 Do all cutting, drilling and patching of the existing building for the installation of your work. Perform all cutting and drilling with proper tools and equipment. Confirm the exact location of cutting and drilling with the Consultant prior to commencing the cutting and/or drilling work.

.2 Patch surfaces, where required, to exactly match existing finishes using tradesmen skilled in the particular trade or application worked on.

.3 Where new pipes pass through existing construction, core drill an opening. Size openings to leave 12 mm (½") clearance around the pipes or pipe insulation.

.4 You will be responsible for the repair of any damage to existing services, exposed or concealed, caused as a result of your cutting or drilling work.

.5 Where drilling is required in waterproof slabs, size the opening to permit snug and tight installation of a pipe sleeve which is sized to leave 12 mm (½") clearance around the pipe or pipe insulation. Provide a pipe sleeve in the opening. Pipe sleeves are to be Schedule 40 galvanized steel pipe with a flange at one end and a length to extend 100 mm (4") above the slab. Secure the flange to the underside of the slab and caulk the void between the sleeve and slab opening with proper non-hardening silicone base caulking compound to produce a water-tight installation.

.22 Packing And Sealing Core Drilled Pipe Openings

.1 Pack and seal the void between the pipe opening and the pipe or pipe insulation for the length of the opening as follows:

.1 Non-fire rated interior construction: pack openings in non-fire rated interior construction with mineral wool and seal both ends of the opening with non-hardening silicone base caulking compound to produce a water-tight seal.

.2 Exterior walls above grade: pack sleeves in exterior walls above grade with mineral wool and seal both ends of the sleeves water-tight with approved non-hardening silicone base caulking compound unless mechanical type seals have been specified.

.3 Exterior walls below grade: seal sleeves in exterior walls below grade (and any other wall where water leakage may be a problem) with link type mechanical seals as specified below.

.23 Cleaning Mechanical Work

.1 Refer to cleaning requirements specified in Division 01.

.2 Clean all mechanical work prior to application for Substantial Performance of the work.

.3 Include for vacuum cleaning the interior of air handling units and ductwork systems.

.24 Maintaining Equipment Prior To Acceptance

.1 Maintain all equipment in accordance with the manufacturer's printed instructions prior to start-up, testing and commissioning.

.2 Employ a qualified millwright to check and align shafts, drives, and couplings on all base mounted split coupled motor driven equipment.

.3 Where equipment lubrication fittings are not easily accessible, extend the fittings to accessible locations using copper or aluminium tubing.

.4 All filters are to be new upon Substantial Performance of the work. This is in addition to any spare filters specified.

.25 Connections To Other Equipment

.1 Carefully examine the Contract Documents during the bidding period and include for mechanical work piping and/or ductwork connections to equipment requiring such connections.

.26 Waste Management And Disposal

.1 Separate and recycle waste materials in accordance with requirements specified in Division 01.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

.1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

.1 This Section specifies thermal insulation requirements that are common to mechanical work Sections of the Specification. It is a supplement to each Section and is to be read accordingly.

1.3 REFERENCES

.1 Definitions:

.1 "concealed" means mechanical services and equipment above suspended ceilings, in non-accessible chases, in accessible pipe spaces, and furred-in spaces

.2 "exposed" means exposed to normal view during normal conditions and operations

.3 "domestic water" means all piping (cold, hot, tempered) extended from the building Municipal supply main

.4 “WHMIS sheets” means Workplace Hazardous Materials Information System sheets

.5 “mineral fibre” means a type of insulation manufactured from molten rock, slag, or glass in accordance with requirements of ASTM C547

.6 “PEX” means cross-linked polyethylene

.7 “insulation system” means insulation material, fasteners, jacket, and any other accessory.

.8 “TIAC” means Thermal Insulation Association of Canada.

.2 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction

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

.1 ASTM A240 – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strap for Pressure Vessels and for General Applications

.2 ASTM B209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

.3 ASTM C534 – Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form

.4 ASTM C547 - Standard Specification for Mineral Fibre Pipe Insulation

.5 ASTM C552 – Standard Specification for Cellular Glass Thermal Insulation

.6 ASTM C553 – Standard Specification for Mineral Fibre Blanket Thermal Insulation

.7 ASTM C612 – Standard Specification for Mineral Fiber Block and Board Thermal Insulation

.8 ASTM C1136 – Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation

.9 ASTM C1290 – Standard Specification for Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts

.10 ASTM D1784 – Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

.2 Thermal Insulation Association of Canada (TIAC):

.1 Best Practices Guide

.2 TIAC Quality Standard 1501

.3 Underwriters Laboratories of Canada (ULC):

.1 CAN/ULC-S101 – Fire Endurance Tests of Building Construction and Materials

.2 CAN/ULC-S114 – Test for Non-Combustibility

1.4 SUBMITTALS

.1 Submittals under this Section shall be in accordance with General Conditions and Section 01 33 00.

.2 Product Data Sheets & WHMIS Sheets:

.1 Submit a product data sheet and a WHMIS sheet for each insulation system product. Product data sheets must confirm that the product conforms to requirements of referenced Codes, Standards, and material properties.

1.5 QUALITY ASSURANCE

.1 Mechanical insulation requirements specified in this Section are based on the Thermal Insulation Association of Canada Best Practices Guide.

.2 Qualifications:

.1 Installer's:

.1 The company with the sub-contract for mechanical insulation work is to be a member in good standing of the Thermal Insulation Association of Canada.

.2 Mechanical insulation is to be applied by journeyman tradespersons in the Heat and Frost Insulation Trade. Registered apprentice tradespersons must be under direct, daily, on-site supervision of a journeyman.

2 PRODUCTS

2.1 MANUFACTURERS

.1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:

.1 Acceptable Manufacturers:

.1 Acceptable insulation product manufacturers are listed in Section 4, Products, of the TIAC Best Practices Guide

.2 Requests for substitutions shall be made in conformance with Section 01 25 00 – Substitution Procedures.

.3 Substitution Limitations:

.1 No further substitutions will be permitted.

.4 Single source responsibility: Obtain each type of valve from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work. Products installed as part of the Work of this Section shall be from the same production run including all extra stock materials.

2.2 MATERIALS

.1 Fire Hazard Ratings:

.1 Unless otherwise specified, all insulation system materials inside the building and above ground must have a fire hazard rating of not more than 25 for flame spread and 50 for smoke developed when tested in accordance with CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.

.2 Thermal Performance:

.1 Unless otherwise specified, thermal performance, i.e. conductivity, of insulation is to meet or exceed the values given in the National Energy Code of Canada for Buildings, and ASHRAE/IES Standard 90.1.

.3 Pipe Insulation Materials:

.1 Horizontal Pipe Insulation at Hangers and Supports: Insulated pipe support inserts consisting of minimum 150 mm (6") long, premoulded, rigid, sectional phenolic foam or fiberglass insulation (of same thickness as adjoining insulation) with a reinforced foil and kraft paper vapour barrier jacket and a 180° captive galvanized steel saddle. Acceptable products are:

.1 Belform Insulation Ltd. "Koolphen K-Block"

.2 Shur-Fit Products Ltd. “Pro-Pipe Supports”

.2 Specialty Insulation for Piping: Factory fabricated foamed glass or closed cell foamed plastic insulation fittings specifically made for pipe mechanical joint fittings and couplings, and pipe risers at riser clamps. Acceptable manufacturers are:

.1 Shur-Fit Products Ltd.

.2 Armacell Canada Inc.

.3 Owens Corning “FOAMGLASS”

.3 TIAC Standard 1501, Code A2, Preformed Mineral Fibre: Rigid, sectional, sleeve type insulation to ASTM Standard C 547, Standard Specification for Mineral Fibre Pipe Insulation, supplied in 915 mm (3’) lengths with a factory applied vapour barrier jacket and adhesive jacket closure.to ASTM C1136, Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation, with a minimum thermal conductivity of 0.033 W @ 24° C.

.4 Insulation Fastenings:

.1 Wire: Minimum #15 gauge galvanized annealed wire.

.2 Tape Sealant: Equal to MACtac Canada Ltd. self-adhesive insulation tapes, types PAF, FSK, ASJ, or SWV as required to match the surface being sealed.

.3 Adhesive - Mineral Fibre Insulation: Clear, pressure sensitive, brush consistency adhesive, suitable for a temperature range of -20°C to 82°C (-4°F to 180°F), compatible with the type of material to be secured, and WHMIS classified as non-hazardous.

.4 Adhesive – Flexible Elastomeric Insulation: Armacell "Armaflex" #520 air-drying contact adhesive.

.5 Adhesive – Closed Cell Foamed Glass Insulation: Equal to Pittsburgh Corning PC88 multi-purpose two-component adhesive.

.6 Lagging Adhesive: White, brush consistency, ULC listed and labelled, 25/50 fire/smoke rated lagging adhesive for canvas jacket fabric, suitable for colour tinting, complete with fungicide and washable when dry.

.7 Sheet Metal Screws: No. 10 stainless steel sheet metal screws.

.5 Insulation Jackets and Finishes:

.1 TIAC Code C11, Canvas: ULC listed and labelled, 25/50 rated, roll form, minimum 170 g (6 oz.) canvas jacket material.

.2 TIAC Code C1, PVC: Roll form sheet and fitting covers in accordance with ASTM D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds, minimum 15 mil thick, white, PVC, 25/50 rated, complete with installation and sealing accessories.

3 EXECUTION

3.1 INSTALLATION

.1 General Insulation Application Requirements:

.1 Unless otherwise specified, do not insulate the following:

.1 Factory insulated equipment and piping.

.2 Do not apply insulation unless leakage tests have been satisfactorily completed.

.3 Ensure that all surfaces to be insulated are clean and dry.

.4 Ensure that the ambient temperature is minimum 13° C (55° F) for at least one day prior to the application of insulation, and for the duration of insulation work, and that relative humidity is and will be at a level such that mildew will not form on insulation materials.

.5 All insulation materials must be stored on site in a proper and dry storage area. Any wet insulation material is to be removed from the site and replaced.

.6 Install insulation directly over pipes and ducts and not over hangers and supports.

.7 Install piping insulation and jacket continuous through pipe openings and sleeves.

.8 Install duct insulation continuous through walls, partitions, and similar surfaces except at fire dampers.

.9 When insulating "cold" piping and equipment, extend insulation up valve bodies and other such projections as far as possible, and protect the insulation jacketing from the action of condensation at its junction with the metal.

.10 When insulating vertical piping risers 75 mm (3”) diameter and larger, use insulation support rings welded directly above the lowest pipe fitting, and thereafter at 4.5 m (15’) centres and at each valve and flange. Insulate as per Thermal Insulation Association of Canada National Insulation Standards, Figure No. 9.

.11 Where mineral fibre rigid sleeve type insulation is terminated at valves, equipment, unions, etc., neatly cover the exposed end of the insulation with a purpose made PVC cover on "cold" piping, and with canvas jacket material on "hot" piping.

.12 Where there is interference between weld bead, mechanical joints, etc., and insulation, use purpose made insulation fittings or otherwise neatly and properly insulate these items to maintain the insulation value of the work. Seal all exposed surfaces of insulation.

.13 Where thermometers, gauges, and similar instruments occur in insulated piping, and where access to heat transfer piping balancing valve ports and similar items are required, create a neat, properly sized hole in the insulation and provide a suitable grommet in the opening.

.14 Where existing insulation work is damaged as a result of a new mechanical work, repair the damaged insulation work to new work standards.

.2 Insulation For Pipe Mechanical Joint Fittings & Couplings, Etc.:

.1 Provide manufactured insulation fittings, the same thickness as the adjoining pipe insulation, for mechanical joint fittings and couplings, and for piping at riser clamps through the floor. Cover with purpose made PVC covers with joints sealed with tape.

.3 Insulation For Horizontal Pipe At Hangers And Supports:

.1 At each hanger and support location for piping 50 mm (2") diameter and larger and scheduled to be insulated, except where roller hangers and/or supports are required, and unless otherwise specified, supply a factory fabricated section of phenolic foam pipe insulation with integral vapour barrier jacket and captive galvanized steel shield. Supply the insulation sections to the piping installers for installation as the pipe is erected.

.4 Pipe Insulation Requirements – Inside Building & Above Ground:

.1 Insulate pipe inside the building and above ground, as scheduled below, in accordance with TIAC Quality Standard 1501, Piping, as follows:

.1 Material: Type A3 mineral fibre.

.2 Insulation application:

.1 1501-H for hot piping.

.2 1501-C for cold piping.

.3 Insulation finish: CPF/1 canvas jacket or CPF/4 PVC jacket for exposed piping.

PIPE SERVICE	**DIAMETER**	**INSULATION THICKNESS**
Domestic Cold Water	to 100 mm	25 mm
	larger than 100 mm	40 mm

PIPE SERVICE	DIAMETER	INSULATION THICKNESS
Storm Drainage From Roof Drains (See Note #1)	all	25 mm
Plumbing Vent, 3 M Back From Roof Penetration	all	25mm
Condensate Drain From A/C Equipment Drain Pans	all	25 mm

Notes:

#1 Insulate storm drainage piping from roof drains from the roof drain to the point where the piping extends straight down, without offsets, and connects to a horizontal main.
#2 Insulate drainage piping from refrigerated drinking fountains from the fountain to nearest 75 mm drain.
#3 TIAC Standard 1501 Code A6 foamed elastomeric insulation may be used in lieu of Type A2, with 1501-CA application and specified finish.
#4 Dry fire protection zone piping drum drips in unheated areas will be traced with electric heating cable.
#5 Use TIAC non-combustible rock slag mineral fibre insulation for insulated pipe penetrating through fire rated construction, and for high temperature piping insulation such a high pressure steam and condensate

.5 Pipe Insulation Requirements – Outside Building & Above Ground:

.1 Insulate pipe outside the building and above ground, as scheduled below, in accordance with TIAC Quality Standard 1501, Piping, as follows:

.1 Material: Type A2 mineral fibre.

.2 Insulation application:

.1 1501-H for hot piping.

.2 1501-C for cold piping.

.3 Insulation finish: CPF/3.

PIPE SERVICE	DIAMETER	INSULATION THICKNESS
Domestic Cold Water	to 25 mm	50 mm
	larger than 25 mm	65 mm
Condenser Water, Supply & Return	to 50 mm	50 mm
	larger than 50 mm	65 mm

Notes:

(a) #1 TIAC Standard 1501, Type A5 insulation with 1501-CA application may be used in lieu of mineral fibre insulation.

.6 Ductwork System Insulation Requirements – Inside Building:

.1 Insulate duct systems inside the building and above ground, as scheduled below, in accordance with TIAC Quality Standard 1502, Ductwork and Plenums, as follows:

.1 Material:

.1 Type A2 rigid mineral fibre for exposed rectangular ducts, and all plenums

.2 Type B2 flexible mineral fibre for concealed rectangular ducts, and concealed and exposed round or oval ducts

.2 Insulation application:

.1 CER/1 for heating and ventilating system rigid insulation

.2 CER/2 for heating and air conditioning system rigid insulation

.3 CEF/1 for heating and ventilation system flexible insulation

.4 CEF/2 for heating and air conditioning system flexible insulation

.3 Insulation finish:

.1 CRF/1 for exposed rectangular duct systems

.2 CRD//1 for exposed round/oval duct systems

DUCT SYSTEM SERVICE	**INSULATION THICKNESS**	
	Rigid Insulation	**Flexible Insulation**
Fresh (Outside) Air Casings And Plenums	40 mm	n/a
Exhaust Air Casings And Plenums Within 3 M Of Exhaust Openings To Atmosphere	25 mm	n/a

Notes:

#1 Provide commercial quality corner bead only on exposed rigid duct, plenum and casing insulation in all equipment rooms, corridors, and similar areas where the insulation is subject to damage.

.7 Duct System Insulation Requirements – Outside Building:

.1 Insulate all exposed exterior ductwork and any associated casings and plenums (except fresh air intake systems) outside the building and above ground, with 20 mm (3/4”) thick flexible foam elastomeric sheet insulation applied in 2 layers with staggered tightly butted joints and secured in place with adhesive in strict accordance with the insulation manufacturer’s instructions. Ensure that sheet metal joints are sealed water-tight prior to the insulation application.

.8 Common Duct System Insulation application Requirements:

.1 At duct connection flanges insulate the flanges with neatly cut strips of the rigid insulation material secured with adhesive to side surfaces of the flange with a top strip to cover the exposed edges of the side strips, then butt the flat surface duct insulation up tight to the flange insulation, or alternatively, increase the insulation thickness to the depth of the flange and cover the top of the flanges with tape sealant.

.2 The installation of fastener pins and washers is to be concurrent with the duct insulation application.

.3 Cut insulation fastener pins almost flush to the washer and cover with neatly cut pieces of tape sealant.

.4 Accurately and neatly cut and fit insulation at duct accessories such as damper operators (with standoff mounting) and pitot tube access covers.

.5 Prior to concealment of insulation by either construction finishes or jacket material, patch all vapour barrier damage by means of tape sealant.

.6 At trapeze hanger locations for rectangular duct install insulation between the duct and the hanger.

.7 At each duct hanger for round duct provide a 100 mm (4") wide full length piece of rigid mineral fibre board insulation between the duct and the hanger.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

.1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

.1 This Section specifies commissioning requirements that are common to mechanical work Sections of the Specification and it is a supplement to each Section and is to be read accordingly.

1.3 REFERENCES

.1 Definitions:

.1 The following are definitions of words used in this Section:

.1 Commissioning: the process of demonstrating to the Owner and Consultant, for the purpose of final acceptance, by means of successful and documented functional performance testing, that all systems and/or subsystems are capable of being operated and maintained to perform in accordance with requirements of the Contract Documents, all as further described below

.2 Commissioning Agent: the commissioning authority who will supervise the commissioning process, and who will recommend final acceptance of the commissioned mechanical work

.3 Start-Up: the process of equipment manufacturer's/supplier's technical personnel, with the Contractor, starting and operating equipment and systems, making any required adjustments, documenting the process, and submitting manufacturer's/supplier's start-up reports to confirm that the equipment has been properly installed and is operational as intended

.4 Operational Performance Testing: testing, adjusting and operating of components, equipment, systems and/or subsystems, by the Contractor, after start-up but before functional performance testing, to confirm that all components, equipment, systems and/or subsystems operate in accordance with requirements of the Contract Documents, including all modes and sequences of control and monitoring, interlocks, and responses to emergency conditions, and including submittal of pre-functional performance testing documentation sheets

.5 Functional Performance Testing: a repeat of successful operational performance testing by the Contractor, in the presence of the Commissioning Agent and Consultant with completed Commissioning Agent's commissioning documentation sheets to document, validate and verify that the equipment, systems and subsystems are complete in all respects, function correctly, and are ready for acceptance

.6 Commissioning Documentation Sheets: prepared sheets for operational performance testing and for functional performance testing supplied by the Commissioning Agent for each piece of equipment/system to be commissioned, each sheet or set of sheets complete with the Project name and number, date of commissioning, equipment/system involved, equipment/system name and model number, equipment tag as per the drawings, and, for each commissioning procedure listed, a column giving the expected data as per the Contract Documents, a column to fill in the observed data during commissioning, and space for signatures of the Contractor and Commissioning Agent

.7 BAS: building automation system

.8 Systems Operating Manual: a manual prepared by the Commissioning Agent to present an overview of the building mechanical systems and equipment to be used by building maintenance personnel to assist them in daily operation of the systems

.9 Validate: to confirm by examination and witnessing tests the correctness of equipment and system operation

.10 TAB: testing, adjusting and balancing

.2 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction

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

.1 ASHRAE Guideline 1.2 – The Commissioning Process for Existing HVAC&R Systems

.2 ASHRAE Guideline 1.5 – Commissioning Smoke Control Systems

.2 Canadian Standards Association (CSA):

.1 CSA Z320 – Building Commissioning Standard and Check Sheets

.2 CSA Z5000 – Building Commissioning for Energy Using Systems

1.4 SUBMITTALS

.1 Submittals under this Section shall be in accordance with Section 01 33 00.

.2 Shop Drawings/Product Data Sheets:

.1 Submit to the Commissioning Agent, 1 copy of each “Reviewed” shop drawing or product data sheet associated with equipment or systems to be commissioned.

.3 Commissioning Plan, Procedures, Schedule and Data Sheets:

.1 Submit for review, a Commissioning Plan with schedule, commissioning procedures for all commissioning events, and a copy of the Commissioning Agent’s commissioning data sheets for all equipment/systems to be commissioned.

.4 Letters to Certify Readiness for Functional Performance Testing:

.1 After successful start-up and submittal of completed start-up forms, submit, for each system or subsystem, a letter to confirm that the system or subsystem is ready for functional performance testing and the commissioning process to commence.

1.5 QUALITY ASSURANCE

.1 Commissioning Agent:

.1 Retain the services of a qualified Commissioning Agent.

.2 Qualifications:

.1 The Commissioning Agent is to meet the following qualifications:

.1 be a member of the Professional Engineers Association in the Province of the work

.2 be a member of the Building Commissioning Association, and a Certified Commissioning Professional (CCP) as designated by the Building Commissioning Association

.3 supply a qualified P. Eng. and a Building Commissioning Association Certified Commissioning Professional (CCP) or an ASHRAE Commissioning Project Management Professional (CPMP) on site to supervise the commissioning process

1.6 WARRANTY

.1 Commissioning Agent Involvement vs Warranty Obligations:

.1 The involvement of the Commissioning Agent performing duties as described in this Section does not in any way void or alter any Contractual warranty obligations.

2 PRODUCTS

2.1 MATERIALS

.1 Testing Equipment:

.1 The Commissioning Agent is to supply all instruments and test equipment required for commissioning procedures.

3 EXECUTION

3.1 COMMISSIONING

.1 Commission the mechanical work in accordance with requirements of this Section of the Specification.

.2 Prerequisites to Commissioning: Prerequisites to successful completion of commissioning are as follows:

.1 Submittal of signed start-up reports.

.2 Completion by the Contractor of system testing, adjusting and balancing, and acceptance of the TAB reports.

.3 Permanent electrical and control connections of all equipment.

.4 Successful completion and documentation of operational performance testing.

.5 Submittal of letters to the Consultant certifying that the systems and subsystems have been started, tested, adjusted, successfully operationally performance tested, are ready for functional performance testing, and are in accordance with requirements of the Contract Documents.

3.2 DEFICIENCIES LISTED DURING COMMISSIONING

.1 Correct deficiencies listed by the Consultant and/or Commissioning Agent during the commissioning process within 10 calendar days unless agreed otherwise with the Consultant, and when deficiencies have been corrected, notify the Consultant and Commissioning Agent at once.

3.3 SYSTEMS TO BE COMMISSIONED

.1 Mechanical systems to be commissioned include, but are not to be limited to, the systems described below.

.2 Cooling Systems: Commissioning of cooling systems is to include all piping, piping specialties, equipment, and control, as well as checking and validating temperature and flow documentation contained in TAB reports. If TAB is not done during the cooling season, a follow-up site visit during the cooling season will be required to confirm proper flows and temperatures, and any required system "fine tuning".

.3 HVAC Chemical Treatment Systems: Commissioning of HVAC chemical treatment systems is to include all feed and monitoring equipment, and testing of system fluids to confirm proper concentration of chemical.

.4 Controls: Control work commissioning is to include confirmation of proper operation of all individual control components, and overall operation of the controls in conjunction with the operation of the connected building systems, including heating season/cooling season testing requirements specified above.

.5 Existing Systems: The following existing systems, revised as part of the mechanical work, are to be commissioned as for new systems:

.1 Cooling Systems

.2 HVAC Chemical Treatment Systems

.3 Controls

3.4 COMMISSIONING PROCESS

.1 The commissioning process is to be performed in stages and is to include, but not be limited to, the following:

.1 Stage 1: Commissioning of mechanical equipment/systems as listed in this Section, which is a prerequisite to an application for Substantial Performance and includes supervising and validating results of functional performance testing, and submittal of the reviewed Systems Operating Manual.

.2 Stage 2: Commissioning work to be performed 12 months after issue of a Certificate of Substantial Performance and which includes supervision of the Contractor’s "fine tuning" of equipment/systems through seasonal occupancy, and any other such work to achieve optimal comfort and performance conditions.

.3 Stage 3: Successful completion of satisfactory equipment/system operation during the first month after issue of a Certificate of Total Performance of the Work.

.4 Stage 4: Successful completion of satisfactory equipment/system operation during the 3rd month after issue of a Certificate of Total Performance of the Work.

.5 Stage 5: Successful seasonal commissioning of the building.

3.5 RESPONSIBILITIES OF THE COMMISSIONING AGENT

.1 Construction Phase: During the construction phase the Commissioning Agent is to:

.1 Review the Contractor’s shop drawings for commissioning related issues, and report any such issues to the Consultant.

.2 As soon as possible after work commences at the site, prepare and issue a Commissioning Plan based on the Contractor’s construction schedule.

.3 Prior to tests, supply and issue operational performance test commissioning data sheets for all equipment and systems to be commissioned.

.4 Monitor and inspect the installation on a regular basis throughout the construction stages, issue reports identifying any issues which may have an impact on the commissioning process, and work with the project team to expeditiously resolve any problems that may arise due to site conditions.

.5 Arrange with the Contractor for on-site commissioning meetings on an as-required basis, to be attended by the Contractor and applicable trades, the Owner, and the Consultant, chair the meetings, and prepare and distribute meeting minutes to all attendees.

.6 Witness and validate tests, identify deficiencies, and issue progress reports.

.7 Coordinate commissioning scheduling with the Contractor.

.8 Review the final TAB report on site with the Contractor, and check 100% of TAB results for fan equipment, 30% of TAB results for duct systems outward from fan equipment, and issue a report to the Consultant.

.9 For smaller multiple items of equipment such as air terminal boxes, fan coil units, backflow preventers, and similar equipment, review completed commissioning data sheets submitted by the Contractor and review data sheet information on-site with the Contractor for 30% of the quantity of each item of equipment.

.10 Review operational performance test commissioning data sheets submitted by the Contractor, then witness and supervise functional performance testing and supervise and direct the commissioning process, validate the commissioning procedures, witness completion of commissioning data sheets by the Contractor, and sign the completed data sheets.

.11 Perform a preliminary review of the Contractor's O & M Manuals, before they are issued to the Consultant, and issue any comments to the Consultant.

.12 Coordinate with the Contractor and Owner the training and instructions by the Contractor and his equipment and system manufacturers/suppliers to the Owner's operating and maintenance personnel, and comment on the quality of the training and instructions to the Consultant.

.13 Prepare and issue to the Owner prior to equipment and system training by the Contractor, the Systems Operation Manual.

.2 Post-Construction Phase: During the post construction phase the Commissioning Agent is to:

.1 Prepare and issue the final report on commissioning, identifying any deficiencies that remain outstanding.

.2 Recommend any training and/or instructions to be given to the Owner's operating and maintenance personnel in addition to training and instructions already given.

.3 After Substantial Performance, witness system checks and validate documentation by the Contractor as follows:

.1 Once during the 1st month of building operation.

.2 Once during the 3rd month of building operation.

.3 Once between the 4th and 10th month of building operation but during a season opposite to the 1st or 3rd month visits.

.4 Ensure that any deficient work resulting from system checks described above are corrected.

.5 3 months after Substantial Performance, attend a question and answer session(s) with the Contractor to answer any questions and concerns related to commissioning work from the Owner's operating personnel.

3.6 RESPONSIBILITIES OF THE CONSULTANT

.1 Construction Phase: Responsibilities of the Consultant are as follows:

.1 Review the Contractor's shop drawing/product data submissions for general conformance requirements of the Contract, and add any review comments made by the Commissioning Agent as applicable.

.2 Review the Contractor's delivery schedule and installation program to ensure that the installation sequences have been coordinated with the construction schedule.

.3 Monitor and inspect the mechanical work throughout the construction stages to ensure that the work is in accordance with requirements of the Contract, witness tests, note deficient work, and ensure that deficient work is corrected.

.4 Attend site commissioning meetings requested by the Commissioning Agent and arranged by the Contractor.

.5 When informed by the Contractor that work is essentially complete, inspect the equipment and systems, issue deficiency reports, and ensure that deficiencies are corrected in a timely manner.

.6 With the Commissioning Agent, review the Commissioning Plan to ensure that proposed tests and the sequencing and methods of tests conform to Contract requirements, and that the testing and commissioning sequences coincide with the construction schedule.

.7 With the Commissioning Agent, certify completion of the commissioning.

3.7 RESPONSIBILITIES OF THE CONTRACTOR

.1 Construction Phase: Responsibilities of the Contractor during the construction phase are as follows:

.1 Prepare and submit an installation schedule which is to include the time schedule for each activity with lead and lag time allowed and indicated, shop drawing/product data and working detail drawing submissions, and major equipment factory testing and delivery dates.

.2 Prepare and submit a commissioning schedule which is to include a time schedule coordinated with the installation schedule referred to above, and allowances for additional time for re-tests as may be required, and update the schedule on a monthly basis as required.

.3 When requested by the Commissioning Agent, arrange site commissioning meetings with the Owner, Consultant, and applicable trades present, to be chaired by the Commissioning Agent who will also prepare and distribute meeting minutes.

.4 Promptly correct all reported deficient work, and report when corrective work is complete.

.5 Where required by Codes and/or the Specification, retain equipment manufacturers/suppliers or independent third parties to certify correct installation of equipment/systems.

.6 Under the supervision of equipment manufacturers/suppliers, start-up and adjust all equipment to design requirements, and submit start-up sheets which include all equipment data such as manufacturer and model number, serial number where applicable, and performance parameters, all signed by the equipment manufacturer/supplier and the Contractor.

.7 Complete the Commissioning Agent's commissioning data sheets for all multiple items of smaller equipment such as air terminal boxes, fan coil units, backflow preventers, etc., submit the sheets to the Commissioning Agent, accompany the Commissioning Agent for an on-site check of 30% of the data sheet information for each type of equipment, and perform any corrective action required as a result of the site checks.

.8 Perform system testing, adjusting and balancing and, when complete, issue a copy of the final report to the Commissioning Agent for review and a site check of results, and perform any corrective work required as a result of site checks by the Commissioning Agent.

.9 In accordance with the updated commissioning schedule and actual progress at the site, certify in writing to the Consultant and the Commissioning Agent that equipment and/or systems are complete, have been checked, started and adjusted, successfully operationally performance tested and documented, and are ready for functional performance testing and the commissioning procedures, giving the Consultant and Commissioning Agent a minimum of 5 working days notice.

.10 Perform system and subsystem functional performance testing in the presence of the Commissioning Agent and under the supervision of the Commissioning Agent, and submit to the Consultant and Commissioning Agent, completed and signed functional performance testing and commissioning data sheets (issued by the Commissioning Agent) and also signed by the Commissioning Agent.

.2 Post-Construction Phase: Responsibilities of the Contractor during the post construction phase are as follows:

.1 Optimize system operation in accordance with the building's occupant's needs and comments using the System Operation Manual prepared by the Commissioning Agent as reference.

.2 Complete all commissioning procedures, activities, and performance verification procedures that were delayed or not concluded during the construction phase.

.3 Accompanied by the Commissioning Agent, complete system checks and "fine tuning" with signed documentation as follows:

.1 Once during the 1st month of building operation.

.2 Once during the 3rd month of building operation.

.3 Once between the 4th and 10th months in a season opposite to the 1st and 3rd month visits.

.4 Correct all deficiencies revealed by the system checks described above, and, where required, involve equipment manufacturer's/supplier's during corrective actions, and report completion of corrective work.

.5 Schedule for 3 months after Substantial Performance and conduct question and answer session(s) at the building with the Owner's operating and maintenance personnel, with the duration of the session(s) dictated by the number of questions and concerns that have to be addressed.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

.1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

.1 This Section specifies mechanical system testing, adjusting, and balancing requirements that are common to mechanical work Sections of the Specification and it is a supplement to each applicable Section and is to be read accordingly.

1.3 REFERENCES

.1 Definitions:

.1 The following are definitions of words used in this Section:

.1 “TAB” – means testing, adjusting and balancing to determine and confirm quantitative performance of equipment and systems and to regulate the specified fluid flow rate and air patterns at the terminal equipment, e.g., reduce fan speed, throttling, etc.

.2 “hydronic systems” – includes heating water, chilled water, glycol-water solution, condenser water, and any similar system

.3 “air systems” – includes all outside air, supply air, return air, exhaust air, and relief air systems

.4 “flow rate tolerance” – means the allowable percentage variation, minus to plus, of actual flow rate values in the Contract Documents

.5 “report forms” – means test data sheets arranged for collecting test data in logical order for submission and review, and these forms, when reviewed and accepted, should also form the permanent record to be used as the basis for required future testing, adjusting and balancing

.6 “terminal” – means the point where the controlled fluid enters or leaves the distribution system, and these are supply inlets on water terminals, supply outlets on air terminals, return outlets on water terminals, and exhaust or return inlets on air terminals such as registers, grilles, diffusers, louvers, and hoods

.7 “main” – means the duct or pipe containing the system’s major or entire fluid flow

.8 “sub-main” – means the duct or pipe containing part of the systems’ capacity and serving two or more branch mains

.9 “branch main” – means duct or pipe servicing two or more terminals

.10 “branch” – means duct or pipe serving a single terminal

.2 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction.

.1 Standards: Testing, adjusting and balancing of the complete mechanical systems is to be performed over the entire operating range of each system in accordance with 1 of the following publications:

.1 National Standards For A Total System Balance published by the Associated Air Balance Council

.2 Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems published by the National Environmental Balancing Bureau

.3 Chapter 37, Testing, Adjusting, and Balancing of ASHRAE Handbook HVAC Applications

1.4 SUBMITTALS

.1 Submittals under this Section shall be in accordance with General Conditions and Section 01 33 00 – Submittals.

.2 Name and Qualifications of Testing and Balancing Agency: Within 30 days of work commencing at the site, submit the name and qualifications of the proposed testing and balancing agency in accordance with requirements of the article below entitled Quality Assurance.

.3 Sample Test Forms: Submit sample test forms, if other than those standard forms prepared by the Canadian Associated Air Balance Council (CAABC) or National Environmental Balancing Bureau (NEBB) are proposed for use.

.4 Drawing Evaluation Report: Submit a report by the Agency to indicate the Agency's evaluation of the mechanical drawings with respect to service routing and location or lack of balancing devices. Include the set of drawings used and marked-up by the Agency to prepare the report.

.5 Site Visit Reports: Submit a report by the Agency after each site visit made by the Agency during the construction phase of this Project.

.6 Draft and Final Reports: Submit a draft report and a final report as specified in Part 3 of this Section.

1.5 CLOSEOUT SUBMITTALS

.1 Submittals under this Section shall be in conformance with Section 01 77 00.

.2 Warranty: Submit a testing and balancing warranty as specified in Part 3 of this Section.

.3 Post Construction Site Visit Reports: Submit reports listing observations and results of post construction site visits as specified in Part 3 of this Section.

1.6 QUALITY ASSURANCE

.1 Testing Agencies:

.1 Testing and Balancing Agency: Employ the services of an independent testing, adjusting, and balancing agency meeting the qualifications specified below, to be the single source of responsibility to test, adjust, and balance the building mechanical systems to produce the design objectives.

.2 The testing, adjusting and balancing agency is to have successfully completed testing, adjusting and balancing of mechanical systems for a minimum of five projects similar to this Project within the past 3 years, and is to be certified as an independent agency in all required categories by 1 of the following:

.1 CAABC - Canadian Associated Air Balance Council

.2 NEBB - National Environmental Balancing Bureau

2 PRODUCTS

Not applicable.

3 EXECUTION

3.1 SCOPE OF WORK

.1 Perform total mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications and comfort conditions, and recording and reporting the results.

.2 Mechanical systems to be tested, adjusted and balanced include:

.1 Cooling Systems: TAB of cooling systems is also to include all piping and equipment fluid temperatures, flows and control, and if TAB is not done during the cooling season, a follow-up site visit during the cooling season will be required to confirm proper flows and temperatures, and any required system "fine.

.2 Existing Systems: The following existing systems, revised as part of the mechanical work, are to be tested, adjusted and balanced as for new systems:

.1 Cooling Systems

3.2 TESTING, ADJUSTING AND BALANCING

.1 General Requirements: Conform to the following requirements:

.1 As soon as possible after award of Contract, the Agency is to carefully examine a white print set of mechanical drawings with respect to routing of services and location of balancing devices, and is to issue a report listing the results of the evaluation.

.2 The set of drawings examined by the Agency is to be returned with the evaluation report, with red line mark-ups to indicate locations for duct system test plugs, and required revision work such as relocation of balancing devices and locations for additional devices.

.3 After review of the mechanical work drawings and specification, the Agency is to visit the site at frequent, regular intervals during construction of the mechanical systems, to observe routing of services, locations of testing and balancing devices, workmanship, and anything else that will affect testing, adjusting and balancing.

.4 After each site visit, the Agency is to report results of the site visit indicating the date and time of the visit, and detailed recommendations for any corrective work required to ensure proper adjusting and balancing.

.5 Testing, adjusting and balancing is not to begin until:

.1 Building construction work is substantially complete and doors have been installed.

.2 Mechanical systems are complete in all respects, and have been checked, started, and adjusted.

.6 All mechanical systems to be tested, adjusted and balanced are to be maintained in full, normal operation during each day of testing, adjusting and balancing.

.7 Obtain copies of reviewed shop drawings of all applicable mechanical plant equipment and terminals, and temperature control diagrams and sequences.

.8 The Agency is to walk each system from the system "head end" equipment to terminal units to determine variations of installation from design, and the system installation trades will accompany the Agency.

.9 The Agency is to check all valves and dampers for correct and locked position, and temperature control systems for completeness of installation before starting equipment.

.10 Wherever possible, the Agency is to lock all balancing devices in place at the proper setting, and permanently mark settings on all devices.

.11 For belt-driven equipment, the Agency is to report to the Commissioning Agent who in turn is to inform the Contractor and Consultant of any situation where sheaves have to be replaced to suit testing and balancing, and replacements are to be done by the Contractor at no cost.

.12 Noise: the Agency is to balance all systems with due regard to objectionable noise which is to be a factor when adjusting fan speeds and performing terminal work such as adjusting air quantities, and should objectionable noise occur at the design conditions, the Agency is to immediately report the problem and submit data, including sound readings, to permit an accurate assessment of the noise problem to be made.

.13 Stratification: the Agency is to check all supply air handling system mixing plenums for stratification, and where the variation of mixed air temperature across coils is found to be in excess of ±5% of design requirements, the Agency is to report the problem and issue a detail sketch of plenum baffle(s) required to eliminate the stratification.

.14 Tolerances: the Agency is to perform testing, adjusting and balancing to within ± 5% of design values, and make and record measurements which are within ± 2% of actual values.

.15 Filters for all air handling systems equipped with air filters, test and balance the systems with simulated 50% loaded (dirty) filters by providing a false pressure drop.

.16 Seasonal requirements: test, adjust and balance air conditioning systems during the summer season and heating systems during winter season, including at least a period of operation at outside conditions within 2.8° C (5° F) wet bulb temperature of maximum summer design condition, and within 5.5° C (10° C) dry bulb temperature of minimum winter design condition, and take final temperature readings during seasonal operation.

.2 Preparation of Reports: Prepare reports as indicated below:

.1 Draft Reports: Upon completion of testing, adjusting, and balancing procedures, prepare draft reports on CAABC or NEBB forms. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports. Submit 2 complete sets of draft reports. Only 1 complete set of draft reports will be returned.

.2 Final Report: Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit 2 complete sets of final reports. Use units of measurement (SI or Imperial) as used on the Project Documents.

.3 Report Format: Report forms are to be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, 3-ring binders. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the divisions listed below, separated by divider tabs:

.1 General Information and Summary

.2 Hydronic Systems

.3 Temperature Control Systems

.4 Report Contents: The Agency is to provide the following minimum information, forms and data:

.1 Inside cover sheet to identify the Agency, the Contractor, and Project, including addresses, e-mail addresses and contact names and telephone numbers and a listing of the instrumentation used for the procedures along with the proof of calibration.

.2 The remainder of the report is to contain the appropriate forms containing as a minimum, the information indicated on the standard CAABC or NEBB report forms prepared for each respective item and system.

.3 The Agency is to include for each system to be tested, adjusted and balanced, a neatly drawn, identified (system designation, plant equipment location, and area served) schematic "as-built" diagram indicating and identifying all equipment, terminals, and accessories.

.4 The Agency is to include report sheets indicating building comfort test readings for all rooms.

.3 Verification of Reports: After the final testing and balancing report has been submitted, the Agency is to visit the site with the Contractor and Consultant to spot check results indicated on the balancing report. The Agency is to supply all labour, ladders, and instruments to complete spot checks. Note that if results of spot checks do not, on a consistent basis, agree with the final report, the spot check procedures will stop and the Agency is to then rebalance the systems involved, resubmit the final report, and again perform spot checks with the Contractor and Consultant.

.4 Certification and Warranty: When the final report has been accepted, the Contractor is to submit to the Owner, in the name of the Owner, a certificate equal to the CAABC National Guaranty Certification or a NEBB Quality Assurance Program Bond, and in addition, the Contractor is to submit a written extended warranty from the Agency covering 1 full heating season and 1 full cooling season, during which time any balancing problems which occur, with the exception of minor revision work done during scheduled site visits, will, at no cost, be investigated by the Agency and reported on to the Owner, and if it is determined that the problems are a result of improper testing, adjusting and balancing, they are to be immediately corrected without additional cost to the Owner.

.5 Post Balancing Site Visits: After acceptance of the final report, the Agency is to perform post testing and balancing site visits in accordance with the following requirements:

.1 Post-testing and balancing site visits are to be made:

.1 Once during the 1st month of building operation.

.2 Once during the 3rd month of building operation.

.3 Once between the 4th and 10th months in a season opposite to the 1st and 3rd month visit.

.2 During each return visit and accompanied by the Owner’s representative, the Agency is to spot rebalance terminal units as required to suit building occupants and eliminate complaints.

.3 The Agency is to schedule each visit with the Contractor and the Owner, and inform the Consultant.

.4 After each follow-up site visit, the Agency is to issue to the Contractor and Consultant a report indicating any corrective work performed during the visit, all abnormal conditions and complaints encountered, and recommended corrective action.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

.1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

.1 Section includes: Provide domestic water piping and valves.

1.3 REFERENCES

.1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction

.1 National Sanitation Foundation (NSF):

.1 NSF/ANSI/CAN 61 – Drinking Water System Components-Health Effects

1.4 SUBMITTALS

.1 Submittals under this Section shall be in accordance with General Conditions and Section 01 33 00.

.2 Product Data:

.1 Product Data: Submit product data sheets for all products specified in Part 2 of this Section except for pipe and fittings, and chlorine.

2 PRODUCTS

2.1 MANUFACTURERS

.1 The products of the following manufacturers listed throughout Part 2 are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification.

.2 Requests for substitutions shall be made in conformance with Section 01 25 00 – Substitution Procedures.

.3 Substitution Limitations:

.1 No further substitutions will be permitted.

.4 Single source responsibility: Obtain each type of valve from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work. Products installed as part of the Work of this Section shall be from the same production run including all extra stock materials.

2.2 MATERIALS

.1 All products specified in this Section that are in contact with domestic water are to be NSF/ANSI/CAN 61 certified.

.2 Pipe, Fittings and Joints

.1 Hard Copper - Solder Joint: Type "L" hard drawn seamless copper to ASTM B88, complete with wrought copper solder type fittings to ASME/ANSI B16.22 and soldered joints using NSF/ANSI 61 certified silver alloy lead-free solder for cold water pipe, and 95% tin/5% Antimony or silver alloy lead free solder for other services, with flux to ASTM B813.

.2 Copper Pressure Coupled Joint: Type "L" hard drawn seamless copper to ASTM B88 with Viega "ProPress" copper fittings with “Smart Connect” feature, EDPM seals, and pressure type crimped joints made by use of a Rigid Tool Co. Model 330-B or Model 330-C electro-hydraulic crimping tool.

.3 Dielectric Unions

.1 Lead-free dielectric unions, each complete with a thermoplastic liner and rated minimum 1725 kPa (250 psi) at 120º C (250º F).

.4 Shut-Off Valves

.1 Brass & Bronze Ball Valves: Lead free, Class 600, 4140 kPa (600 psi) non-shock WOG rated, 2-piece, full port ball type valves, each complete with a forged brass or bronze body, blowout-proof stem, solid forged brass or bronze chrome plated ball, "Teflon" or "PTFE" seat, a removable coated steel lever handle marked with valve identification, and ends to suit the piping being connected. Valves in insulated piping are to be complete with stem extensions. Acceptable manufacturers are:

.1 Toyo Valve Co.

.2 Milwaukee Valve Co.

.3 Kitz Corporation

.4 Combraco Industries Inc. Apollo

.5 Watts Water Technologies Inc.

.5 Check Valves

.1 Horizontal: Class 125, bronze, lead-free with identifying tag, 1380 kPa (200 psi) WOG rated horizontal swing type check valves with ends to suit the connecting piping. Acceptable products are:

.1 Toyo Valve Co.

.2 Milwaukee Valve Co.

.3 Kitz Corporation

.4 Combraco Industries Inc. Apollo

.5 Watt Water Technologies Inc.

.2 Vertical: Equal to Kitz Corp. Code 26, bronze, lead-free, 1725 kPa (250 psi) WOG rated vertical lift check valve with ends to suit the connecting piping.

.6 Drain Valves:

.1 Refer to Part 2 of the mechanical work Section entitled Basic Mechanical Materials and Methods

.7 Pressure Reducing Valves

.1 For piping to and including 50 mm (2") diameter, lead free, non-corrosive, non-ferrous direct spring acting pressure reducing valves to CAN/CSA B356, Water Pressure Reducing Valves for Domestic Water Supply Systems, each:

.1 Factory set at 345 kpa (50 psi) unless otherwise specified or required

.2 Field adjustable from 175 kpa (25 psi) to 520 kpa (75 psi)

.3 Complete with an integral inlet strainer.

.2 Acceptable products are:

.1 Conbraco 36C Series

.2 Zurn/Wilkins 600XL Series

.3 Watts Industries (Canada) Inc. #LF25AUB Series

.4 Cash-Acme EB-25 Series

.5 Caleffi Hydronic Solutions

.3 For piping 65 mm (2½") diameter and larger, non-corrosive pilot operated pressure reducing valve to CAN/CSA B356, Water Pressure Reducing Valves for Domestic Water Supply Systems, each:

.1 factory set at the required pressure

.2 field adjustable

.3 complete with screwed or flanged connections

.4 complete with a brass body pilot valve with stainless steel seat

.5 Acceptable products are:

.1 Singer Valve Model 106-PR

.2 Zurn/Wilkins Model ZW109

.3 Watts Industries (Canada) Inc. Series N223

.8 Chlorine

.1 Sodium hypochlorite to AWWA B-300, Hypochlorites.

3 EXECUTION

3.1 PREPARATION

.1 Demolition / Removal :

.1 Do all required domestic water system demolition work. Refer to demolition requirements specified in the mechanical work Section entitled Demolition and Revision Work.

3.2 INSTALLATION

.1 Piping Installation Requirements

.1 Provide all required domestic water piping.

.2 Piping, unless otherwise specified, is to be as follows:

.1 for pipe inside building and above ground - Type "L" hard copper with solder joints or, **at your option**, Type "L" hard copper with pressure coupled mechanical joints, or Type 304/304L stainless steel with screwed joints or grooved end coupling joints

.3 Slope all piping so that it can be completely drained.

.4 Provide proper dielectric unions in all connections between copper pipe and ferrous pipe or equipment.

.5 Secure trap seal primer tubing embedded in concrete to reinforcing steel in a secure manner and be present during the concrete pour to ensure that the tubing is not damaged or dislodged.

.2 Installation Of Shut-Off And Check Valves

.1 Refer to Part 3 of the mechanical work Section entitled Basic Mechanical Materials and Methods.

.2 Valves to and including 100 mm (4”) diameter are to be ball type. Valves larger than 100 mm (4”) diameter are to be butterfly type.

.3 Valves in CPVC rigid piping are to be Ipex “Aquarise” CPVC ball valves.

.3 Installation of Drain Valves

.1 Refer to Part 3 of the mechanical work Section entitled Basic Mechanical Materials and Methods.

.4 Installation Of Pressure Reducing Valves

.1 Provide domestic water pressure reducing valves in piping where shown and/or specified. Install so that each valve is readily accessible. Whenever possible, provide pressure reducing valves factory pre-set to required pressures.

.2 Check and test operation and adjust as required.

3.3 SYSTEM STARTUP

.1 Flushing and Disinfecting Piping:

.1 Flush and disinfect all new and/or reworked domestic water piping after leakage testing is complete.

.2 Isolate new piping from existing piping prior to flushing and disinfecting procedures.

.3 Flush piping until all foreign materials have been removed and the flushed water is clear. Provide connections and pumps as required. Open and close valves, faucets, hose outlets, and service connections to ensure thorough flushing.

.4 When disinfecting is complete, submit water samples to a certified laboratory for purity testing and, when testing indicates pure water in accordance with governing standards, submit a copy of the test results and fill the systems.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

.1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

.1 Section includes: Provide drainage waste and vent piping and valves.

1.3 REFERENCES

.1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction

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

.1 ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

.2 ASTM B306 - Standard Specification for Copper Drainage Tube (DWV)

.2 Canadian Standards Association (CSA):

.1 CAN/CSA-B70 -

.2 CAN/CSA B182.2 - PVC Sewer Pipe and Fittings (PSM Type)

.3 CAN/CSA-B602 -

.3 Underwriters Laboratories of Canada (ULC):

.1 CAN/ULC-S102.2 – Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies.

.2 CAN/ULC-S115 - Standard Method Of Fire Tests Of Firestop Systems

1.4 SUBMITTALS

.1 Submittals under this Section shall be in accordance with General Conditions and Section 01 33 00 – Submittals.

.2 Product Data:

.1 Product Data: Submit product data sheets for all products specified in Part 2 of this Section except for pipe and fittings.

2 PRODUCTS

2.1 MANUFACTURERS

.1 The products of the following manufacturers listed throughout Part 2 are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification.

.2 Requests for substitutions shall be made in conformance with Section 01 25 00 – Substitution Procedures.

.3 Substitution Limitations:

.1 No further substitutions will be permitted.

.4 Single source responsibility: Obtain each type of valve from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work. Products installed as part of the Work of this Section shall be from the same production run including all extra stock materials.

2.2 MATERIALS

.1 Pipe, Fittings and Joints:

.1 Above Ground PVC - DWV: Rigid IPS PVC drain, waste and vent pipe and fittings to CAN/CSA B181.2, complete with a flame spread rating less than 25 and a smoke developed rating less than 50 when tested to CAN/ULC-S102-2, solvent weld joints, and, for fire barrier penetration, approved firestop conforming to CAN4-S115.

.2 Copper- Solder Joint: Type DWV hard temper to ASTM B306, with forged copper solder type drainage fittings and 50% lead - 50% tin solder joints.

.3 Cast Iron: Class 4000 cast iron pipe and fittings to CAN/CSA-B70, cast iron soil pipe, fittings, and means of joining, and mechanical coupling joints to CAN/CSA-B602, Mechanical couplings for drain, waste, and vent pipe and sewer pipe, equal to Anaco “Husky” Series 400, 4-strap type for pipe to 100 mm (4”) and 6-strap type for piping larger than 100 mm (4”).

.4 Galvanized Steel - Victaulic Coupling Joint: Schedule 40 mild steel, galvanized, ASTM A53, factory or site rolled grooved, complete with Victaulic galvanized ductile iron grooved end fittings and, unless otherwise specified, Victaulic Style 77 hot dip galvanized mechanical joint couplings with Grade M gaskets.

.5 Carrier & Containment Exposed PVC: Rigid IPS PVC drain, waste and vent pipe and fittings to CAN/CSA B181.2, complete with a flame spread rating less than 25 and, where required, a smoke developed rating less than 50 when tested to CAN/ULC-S102-2, and solvent weld joints.

3 EXECUTION

3.1 PREPARATION

.1 Demolition / Removal:

.1 Do all required drainage and vent piping demolition work. Refer to demolition requirements specified in the mechanical work Section entitled Demolition and Revision Work.

3.2 INSTALLATION

.1 Drain and Vent Piping Installation Requirements:

.1 Provide all required drainage and vent piping. Pipe, unless otherwise specified, is to be as follows:

.1 for pipe inside the building and above ground in sizes to and including 65 mm (2½") diameter - type DWV copper

.2 for pipe inside the building and above ground in sizes 75 mm (3") diameter and larger - Class 4000 cast iron with 4-strap couplings for pipe to and including 100 mm (4") diameter, and 6-strap couplings for piping larger than 100 mm (4") diameter, all with torque wrench tightened bolts, and, where pipe riser/building expansion will or may be a problem, cast iron pipe expansion joints equal to Bibby-Ste-Croix 654 Series

.3 for pipe inside the building and above ground in lieu of type DWV copper and cast iron, at your option and where permitted by governing Codes and Regulations – 25/50 rated rigid IPS PVC drain, waste and vent pipe

.4 for piping inside the building above equipment in areas such as Electrical Rooms, Communication Rooms, etc., PVC carrier/containment piping, 25/50 rated where required

.2 Unless otherwise specified, slope horizontal drainage piping above ground in sizes to and including 75 mm (3") diameter 25 mm (1") in 1.2 m (4'), and pipe 100 mm (4") diameter and larger 25 mm (1") in 2.4 m (8').

.3 Install and slope underground drainage piping to inverts or slopes indicated on the drawings to facilitate straight and true gradients between the points shown. Verify available slopes before installing the pipes.

.4 Unless otherwise specified, slope horizontal branches of vent piping down to the fixture or pipe to which they connect with a minimum pitch of 25 mm (1") in 1.2 m (4').

.5 Extend vent stacks up through the roof generally where shown but with exact locations to suit site conditions and in any case a minimum of 3 m (10') from fresh air intakes. Terminate vent stacks a minimum of 330 mm (13") above the roof (including roof parapets) in vent stack covers.

.6 Provide mechanical joint couplings at connections between copper pipe and ferrous pipe or equipment. Fitting shall include interior shoulder which provides a smooth surface for drainage and prevents contact between dissimilar metals.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

.1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

.1 Section includes: Provide hydronic piping and valves.

.2 Related sections: The following is included for reference only and shall not be presumed complete:

.1 Section 23 21 16 – Hydronic Piping Specialties

.2 Section 23 25 00 – HVAC Water Treatment

1.3 REFERENCES

.1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction

.1 American Society of Testing and Materials (ASTM):

.1 ASTM A53, Standard Specification for Pipe, Steel, Black, and Hot-Dipped, Zinc-Coated, Welded and Seamless

.2 ASTM B88, Standard Specification for Seamless Copper Water Tube

.3 ASTM A105, Standard Specification for Carbon Steel Forgings for Piping Applications

.4 ASTM A234, Standard Specification for Piping Fittings of Wrought Carbon Steel for Moderate and High Temperature Service

.5 ASTM A536, Standard Specification for Ductile Iron Castings

.2 American National Standards Institute (ANSI):

.1 ANSI/ASME B16.4, Cast Iron Threaded Fittings

.2 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

1.4 SUBMITTALS

.1 Submittals under this Section shall be in accordance with General Conditions and Section 01 33 00 – Submittals.

.2 Product Data:

.1 Product Data: Submit product data sheets for all products specified in Part 2 of this Section except for pipe and fittings, and chlorine.

.3 Test and Evaluation Reports:

2 PRODUCTS

2.1 MANUFACTURERS

.1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:

.1 Acceptable Manufacturers:

.1 Valves (Bronze, Cast Iron)

.1 Kitz

.2 Nibco

.3 Toyo

.2 Valves (Steel)

.1 Bonney Forge

.2 Kitz

.3 Beric

.3 Butterfly Valves

.1 Kitz

.2 Bray

.3 Nibco

.4 Toyo

.5 W-K-M

.4 Circuit Balancing Valves

.1 Tour & Andersson

.2 Requests for substitutions shall be made in conformance with Section 01 25 00 – Substitution Procedures.

.3 Substitution Limitations:

.1 No further substitutions will be permitted.

.4 Single source responsibility: Obtain each type of piping specialty from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work. Products installed as part of the Work of this Section shall be from the same production run including all extra stock materials.

2.2 MATERIALS

.1 Pipe, Fittings And Joints:

.1 Black Steel - Screwed Joint: Mild black carbon steel, Grade B, ERW, ASTM A53, complete with Class 125 cast iron threaded fittings to ANSI/ASME B16.4, and screwed joints.

.2 Black Steel - Welded Joint: Mild black carbon steel, Grade B, ERW, ASTM A53, mill or site bevelled, complete with factory made seamless carbon steel butt welding fittings to ASTM A234, Grade WPB, with long sweep pattern elbows unless otherwise specified, and welded joints.

.3 Black Steel - Grooved End Mechanical Joint: Mild black carbon steel, Grade B, ERW, ASTM A53, factory or site roll grooved, complete with Victaulic Co. (or equal) cast ductile iron grooved end fittings, including full flow elbows, conforming to ASTM A536, and Victaulic Style 07 "Zero-Flex" (or equal) rigid couplings for piping in the Mechanical Rooms and for piping risers, Style 77 (or equal) standard flexible couplings for all other piping.

.4 Black Steel - Pressure Coupled Joint: Schedule 10 mild black steel, ASTM A53, square cut, deburred and clean, complete with Viega “MegaPress” 2070 kPa (300 psi) rated, formed, cold drawn steel fittings and couplings with Grade "E" EDPM O-rings and “Smart Connect” feature, and pressure type crimped joints made by use of an electro-hydraulic crimping tool supplied by the fitting manufacturer.

.2 Piping Unions:

.1 Screwed Piping: Malleable iron, ground joint, bronze or brass to iron or bronze to bronze seat screwed unions and union elbows with a minimum pressure rating of 1725 kPa (250 psi) steam at 260° C (500° F).

.2 Flanged Piping: Forged carbon steel slip-on type raised faced welding flange unions to ASTM A105, 150 lb. Class for steel pipe, and slip-on type 150 lb. Class bronze flanges for copper pipe.

.3 Shut-off valves:

.1 Ball Type: Class 600, 4140 kPa (600 psi) WOG rated full port 2-piece ball valves, each complete with:

.1 A forged brass or bronze body and cap.

.2 Blowout-proof stem.

.3 Solid forged brass chrome plated ball.

.4 "Teflon" or "PTFE" seat.

.5 Ends to suit the piping being connected.

.6 Removable and identified lever handle.

.2 Butterfly Type: Cast ductile iron, lug body style, 1200 kPa (175 psi) rated butterfly valves, each suitable for bubble-tight dead end service with the valve closed and either side of the connecting piping removed, and each complete with:

.1 A neck to permit 50 mm (2") of insulation above the flange.

.2 A field replaceable EPDM seat.

.3 Ductile iron disc.

.4 Stainless steel shaft with EPDM seal.

.5 A lever handle for valves to and including 150 mm (6") diameter, and a handwheel and gear type operator for valves larger than 150 mm (6") diameter.

.4 Swing Check Valves:

.1 Bronze - Screwed: Class 125, 1380 kPa (200 psi) WOG rated horizontal swing check valves, each complete with:

.1 A "Y" pattern bronze body.

.2 Hinged brass disc.

.3 Easy access screw-in cap.

.4 Screwed ends.

.2 Steel - Grooved Ends: Victaulic Co. of Canada Ltd. Series 716 "Vic-Check" grooved end carbon steel check valves suitable for mounting horizontally or vertically.

.3 Cast Iron - Screwed and Flanged: Cast iron, bronze trim, 1380 kPa (200 psi) rated swing check valves, each complete with

.1 A bronze disc and seat.

.2 Malleable iron hinge.

.3 Bolted cover.

.4 Screwed or flanged ends as required.

.5 Vertical Lift Check Valves:

.1 Class 150, 1380 kPa (200 psi) WOG rated bronze body vertical lift check valves, each complete with:

.1 A conical brass disc.

.2 Stainless steel, bushing, guide rod, and spring.

.3 PTFE seat.

.4 Screwed ends.

.6 Wafer Check Valves:

.1 Threaded lug body type, full bore, ANSI Series 150, 1965 kPa (285 psi) rated at 38° C (100° F), non-slam wafer check valves, each complete with:

.1 A carbon steel body.

.2 Disc, a shaft, spring, disc stop and thrust bearings constructed of type 316 stainless steel.

.3 Seat materials to suit the application.

.7 Drain Valves:

.1 Refer to Part 2 of the mechanical work Section entitled Basic Mechanical Materials and Methods.

.8 Circuit Balancing Valves:

.1 Globe style, “Y” pattern circuit balancing valves designed to facilitate precise flow measurement, precision flow balancing, and positive shut-off, each rated for 2070 kPa at 120° C (300 psi at 250° F) and complete with:

.1 A brass body, stem and plug for valves to 50 mm (2”) diameter, and a cast or ductile iron body with bronze plug disc and stem for valves larger than 50 mm (2”) diameter.

.2 A multi-turn, 360° adjustment handwheel with micrometer type indicators and a lockable hidden memory feature.

.3 Two 6.4 mm (¼”) threaded brass metering ports with check valves and gasketed caps on the inlet side of the valve for connection to a differential pressure meter.

3 EXECUTION

3.1 INSTALLATION

.1 Demolition:

.1 Do all required hydronic piping system demolition/revision work. Refer to demolition requirements specified in the mechanical work Section entitled Demolition and Revision Work.

.2 Piping Installation Requirements:

.1 Provide all required hydronic piping. Pipe, unless otherwise specified, is to be:

.1 For pipe to and including 65 mm (2½") diameter, Schedule 40 black steel, screwed, or type "L" hard copper with solder joints or pressure coupled joints, or, for runout piping from mains and risers to terminal equipment, Schedule 10 black steel with Viega "MegaPress" fittings and couplings.

.2 For pipe 65 mm (2½") diameter and larger, Schedule 40 black steel with grooved ends and Victaulic fittings and couplings, or, Schedule 40 black steel with welding fittings and welded joints.

.2 Slope horizontal piping mains to provide a minimum continuous up-grade of 25 mm (1") in 6 m (20') to high points. Slope branch supply and return piping connections to equipment a minimum of 25 mm (1") in 1.2 m (4'). Leave sufficient room at high points for installation and maintenance of air vents.

.3 Install automatic control valves, piping wells and similar piping and/or equipment mounted control components required for automatic temperature control systems supplied as part of the control. Refer to drawing control diagrams and details.

.4 Connect equipment provided as part of the work of other Sections of the Specification with piping as indicated and/or required. Refer to pipe connection details on drawings.

.5 Unions: Provide screwed unions, removable mechanical joint couplings, or weld-on or solder-on flanges in piping at all connections to valves, strainers and similar piping system components which may need maintenance or repair, at all equipment connections, in runs of piping exceeding 9 m (30') at 4.5 m (15') regular intervals to permit removal of sections of piping, and wherever else indicated on the drawings.

.6 Shut-off Valves: Provide shut-off valves in piping connections to equipment, to isolate piping risers, to isolate other sections of systems as shown, and wherever else indicated on the drawings. Valves in piping to and including 50 mm (2") diameter are to be ball type. All other shut-off valves are to be ball or butterfly type unless otherwise specified. Locate all valves so that they are easily accessible. Wherever possible, install valves at uniform height. Provide chain operators for valves which are inaccessible for operation from floor level.

.7 Check Valves: Provide a check valve in the discharge piping of every pump, and elsewhere in piping where shown on the drawings. Where check valves are required in vertical piping, ensure that they are suitable in all respects for the application. Note that check valves for vertical in-line and/or base mounted circulating pumps are integral with the discharge accessory.

.8 Drain Valves: Refer to Part 3 of the mechanical work Section entitled Basic Mechanical Materials and Methods.

.9 Circuit Balancing Valves: Provide circuit balancing valves in piping generally where shown on the drawings but with exact locations in accordance with instructions of personnel doing system flow balancing work. Confirm locations prior to installation.

.3 Flushing And Cleaning Piping:

.1 Flush and clean new piping in accordance with requirements specified in the mechanical work Section entitled HVAC Water Treatment.

.4 Testing, Adjusting And Balancing:

.1 When work is complete and equipment is operating as intended, test, adjust and balance water flows in accordance with requirements specified in the mechanical work Section entitled Testing, Adjusting, and Balancing.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

.1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

.1 Section includes: Provide hydronic piping specialties.

.2 Related sections: The following is included for reference only and shall not be presumed complete:

.1 Section 23 21 13 – Hydronic Piping and Valves

.2 Section 23 25 00 – HVAC Water Treatment

1.3 REFERENCES

.1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction

.1 American Society of Mechanical Engineers (ASME)

.1 ASME Boiler and Pressure Vessel Code

1.4 SUBMITTALS

.1 Submittals under this Section shall be in accordance with General Conditions and Section 01 33 00 – Submittals and Division 20.

.2 Product Data:

.1 Product Data: Submit product data sheets for all products specified in Part 2 of this Section except for pipe and fittings, and chlorine.

.3 Test and Evaluation Reports:

.1 Backflow Preventer Inspection/Test Results: Submit signed test results and inspection and test log cards for each backflow preventer as specified in Part 3 of this Section.

.4 Anchor Fabrication Drawing: Submit anchor shop drawing(s) to detail the fabrication and installation of water piping anchors. The drawing(s) must be prepared and stamped by a Professional Structural Engineer registered and licensed in the jurisdiction of the work.

.5 Anchor Installation Certification: As specified in Part 3 of this Section, submit a letter from the anchor design engineer stating that the anchor installation has been examined at the site and the anchors are properly fabricated and installed.

2 PRODUCTS

2.1 MANUFACTURERS

.1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:

.1 Acceptable Manufacturers:

.1 Safety Relief Valves

.1 Consolidated

.2 Fisher

.2 Air Eliminators / Air Vents

.1 Spirax Sarco

.2 Crane Supply, Brownall

.3 Taco

.3 Strainers

.1 Sarco

.2 Armstrong

.3 Zurn

.4 Bladder Air Cushion Tanks

.1 Amtrol

.2 Expanflex

.3 ITT

.4 Taco

.5 Glycol Fill Systems

.1 Axiom Industries

.2 Ashland Drew

.2 Requests for substitutions shall be made in conformance with Section 01 25 00 – Substitution Procedures.

.3 Substitution Limitations:

.1 No further substitutions will be permitted.

.4 Single source responsibility: Obtain each type of piping specialty from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work. Products installed as part of the Work of this Section shall be from the same production run including all extra stock materials.

2.2 MATERIALS

.1 Pressure Relief Valves:

.1 ASME tested, rated, and certified, bronze, brass, or cast iron bronze fitted, 1725 kPa (250 psi) rated pressure relief valves, each permanently identified and capable of relieving the full output of the equipment it is associated with, each factory set at the required pressure, and each complete with:

.1 A CRN.

.2 NPT inlet and outlet (drain) connections.

.3 Non-stick, non-freeze disc-to-metal seating.

.4 A stainless steel spring.

.5 A test lever.

.2 Air Vents:

.1 Manual Air Vents: Brass or bronze manual air vent with NPT connection, chrome plated where located exposed in finished areas, each maximum 1035 kPa (150 psi) rated at 100° C (212° F), and equipped with:

.1 A knurled handwheel.

.2 A discharge nozzle.

.3 An integral check valve.

.4 A fibre hygroscopic disc.

.2 Automatic Air Vents: Float actuated air vents, each suitable in all respects for the system operating pressure and temperature, and equipped with:

.1 A brass body and cover with vent cap, and NPT connection.

.2 A stainless steel or high temperature resistant polyethylene float assembly and seal.

.3 Inlet vacuum breaker.

.3 Strainers:

.1 Refer to Part 2 of the mechanical work Section entitled Basic Mechanical Materials and Methods.

.4 Flexible Pump Connections:

.1 Flexible type 321 stainless steel hose and braid assemblies, each minimum 300 mm (12”) long, suitable for twice the working pressure of the system and complete with Schedule 40 carbon steel connection nipples or 150 lb. forged steel slip-on flanges at each end.

.5 Air Separator:

.1 Vortex type, vertical, cast iron or fabricated steel air separator constructed for a pressure of 860 kPa (125 psi) at 180° C (350° F) in accordance with Section VIII, Division 1 of the ASME Boiler and Pressure Vessel Code, sized to the inlet pipe size and equipped with:

.1 NPT, flanged, or grooved end side tangential inlet and outlet connections, depending on separator size and site piping connections.An NPT top air outlet connection, and NPT bottom drain connection.A blowdown connection for routine cleaning.

.6 Expansion Tank:

.1 Replaceable bladder type, factory pressurized expansion tank with permanent separation of air and water, as per the drawing schedule and complete with:

.1 A steel pressure tank suitable for a working pressure of 870 kPa (125 psi) at 115° C (240° F), constructed and stamped in accordance with Section VIII of the ASME Code for Unfired Pressure Vessels.

.2 An NPT system connection, and a tire type air charging connection.

.3 A red oxide primer finish.

.4 A heavy-duty butyl rubber (EDPM) bladder.

.5 A tapping for installation of a pressure gauge.

.6 For a horizontal tank, mounting saddles supplied loose.

.7 For a vertical tank, a ring type base and lifting rings.

.8 Factory secured seismic restraint connection hardware.

.7 Glycol Solution Mixing And Storage Tank:

.1 Package type glycol solution mixing, storage and automatic feed assembly designed to maintain minimum system pressure levels and complete with:

.1 A round, polyethylene or polypropylene tank complete with a solution level scale in litres and Imperial gallons, and removable cover.

.2 A welded steel angle stand assembly with legs, pump shelf, and control panel bracket, all factory finished with enamel.

.3 A factory pre-piped minimum 115 volt, 1 phase rotary bronze gear pump factory wired to the control panel, mounted on a shelf integral with the steel stand assembly, and complete with shut-off valve and strainer.

.4 A tank pressure relief valve with discharge piped back into the tank.

.5 A tank low level switch.

.6 A pressure gauge.

.7 A Honeywell #L404A "Pressurtrol" or equal pipe mounting differential pressure switch with a 100-1000 kPa (15-150 psi) range.

.8 A 115 volt, 1 phase, factory mounted and prewired control panel with an EEMAC 2 enamelled steel enclosure, designed to control and operate the glycol gear pump either manually or automatically to pump glycol solution into the system, and to stop the pump and initiate on audible/visual alarm if a low glycol solution level occurs in the tank, and complete with:

.1 Terminal blocks for power and control wiring connections.

.2 A H-O-A switch with green "Power On" indicator light.

.3 A control transformer.

.4 A low glycol solution level alarm buzzer with silencing switch, an alarm light which remains illuminated until the low-level switch is reset, and an alarm push-to-test button.

.5 Dry contacts for building automation system alarm annunciation.

.9 Factory secured seismic restraint connection hardware.

.8 Glycol:

.1 Propylene glycol blended with Nitrite based corrosion inhibitors.

.9 Piping Expansion & Contraction Hardware & Anchors:

.1 Refer to Part 2 of the mechanical work Section entitled Piping Expansion Compensation.

3 EXECUTION

3.1 INSTALLATION

.1 Installation Of Pressure Relief Valves:

.1 Provide factory set pressure relief valves where shown. Pipe the discharge of each water piping relief valve to drain unless otherwise shown or specified.

.2 Pipe the discharge of each glycol solution piping relief valve back to the system expansion tank or return piping.

.3 Confirm relief valve settings.

.2 Installation Of Air Vents:

.1 Provide an air vent in piping mains at all high points, at equipment connections, and wherever else shown and/or specified. Equip each air vent with a ball type shut-off valve. Install vents in 100 mm (4") diameter and larger piping and all vents in mechanical rooms in accordance with the drawing detail.

.3 Installation Of Strainers:

.1 Refer to Part 3 of the mechanical work Section entitled Basic Mechanical Materials and Methods.

.4 Installation Of Piping Expansion Compensation Hardware & Anchors:

.1 Refer to Part 3 of the mechanical work Section entitled Basic Mechanical Materials and Methods.

.5 Installation Of Air Separator:

.1 Provide an air separator in piping where shown and connect with valved inlet and outlet piping.

.2 Extend valved blow down piping from the bottom pipe connection tapping to the nearest floor drain location.

.3 Equip the top pipe connection tapping with an automatic air vent, and piping as detailed.

.6 Installation Of Expansion Tank:

.1 Provide an expansion tank where shown.

.2 Secure the horizontal expansion tank in place from the structure by means of properly sized galvanized steel hanger rods and support saddles supplied with the tank.

.3 Secure the tank stand to a concrete housekeeping pad by means of machine bolts. Connect the tank with system piping as indicated.

.4 Connect the tank with system piping as indicated. Extend a drain line from the tank piping as indicated and terminate the drain line with a drain valve. Provide an air vent.

.5 Provide a water make-up connection line complete with relief valve and pressure gauge and connect to system piping as shown. Terminate the make-up piping for connection to domestic cold water piping as part of the work of the mechanical work Section entitled Domestic Water Piping and Valves. Check relief valve operation and adjust as required.

.6 Check the tank air charge and adjust to suit the system.

.7 Installation Of Glycol Solution Mixing – Storage Tank:

.1 Provide a mixing - storage tank and feed assembly for each glycol solution circulating system as shown.

.2 Secure the tank stand to a concrete housekeeping pad. Connect with system piping. Refer to the drawing detail.

.3 Fill the tank with, unless otherwise specified, a solution of 50% water, 50% propylene glycol, and test the solution to confirm proper concentrations. Submit a signed test report confirming the solution percentages.

.4 When installation is complete, test operation of the assembly, including alarms, and adjust as required. Adjust the pressure switch to suit the glycol solution circulating system pressure.

.8 Installation Of Flexible Piping Connections:

.1 Provide flexible connections in piping connections to equipment where shown.

.2 Install in accordance with the manufacturer’s instructions.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

.1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

.1 Section includes: Provide HVAC water treatment

1.3 SUBMITTALS

.1 Submittals under this Section shall be in accordance with General Conditions and Section 01 33 00 and Division 20.

.2 Product Data:

.1 Product Data: Submit product data sheets for all products specified in Part 2 of this Section except for pipe and fittings, and chlorine.

.3 Shop Drawings:

.1 Submit shop drawings indicating system configuration and cleaning procedures.

.4 Test and Evaluation Reports:

.1 Chemical Treatment Inspection/Test Results: Submit signed test results and inspection and test log cards for each system as specified in Part 3 of this Section.

1.4 MAINTENANCE MATERIALS SUBMITTALS

.1 Extra stock materials:

.1 Spare filters

.2 Spare chemical

2 PRODUCTS

2.1 MANUFACTURERS

.1 The products of the manufacturers noted throughout Part 2 are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification.

.2 Requests for substitutions shall be made in conformance with Section 01 25 00 – Substitution Procedures.

.3 Substitution Limitations:

.1 No further substitutions will be permitted.

.4 Single source responsibility: Obtain each type of piping specialty from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work. Products installed as part of the Work of this Section shall be from the same production run including all extra stock materials.

2.2 MATERIALS

.1 Characteristics Of Chemicals:

.1 All chemicals specified in this Section are to be non-toxic when released to atmosphere, non-corrosive and non-staining if a leak occurs, and compatible with all system components.

.2 All chemicals must be approved by governing authorities for release into the Municipal sewer system.

.2 Existing Treatment Systems:

.1 The Owner has a contract with a treatment chemical supplier to maintain proper levels of chemical in the building systems. New chemicals and/or treatment delivery hardware are to be supplied by this supplier. Obtain the supplier's name during the bidding process and obtain the required pricing information.

.3 Piping System Flushing and Cleaning Chemical:

.1 Liquid form alkaline type cleaner consisting of a concentrated blend of highly active penetrating agents and detergents with a 12.5 pH and specifically formulated to remove oil, mill scale and oxides from piping and equipment.

.4 Open Heat Transfer System Treatment:

.1 Chemicals, chemical feed equipment, and test equipment to control corrosion and scale formation and inhibit algae/bacteria growth in open heat transfer circulating systems as indicated on the drawings and as specified below.

.2 Chemicals: Treatment chemicals are to be equal to the following Drew Canada chemicals:

.1 "Performax Millennium" Series #2395 corrosion inhibitor and deposit control in a drum type container.

.2 "Biocide T" slime control agent in a pail type container.

.3 "Biosphere 250" for control of bacteria, fungi, and algae, and supplied in pail or drum type containers as required.

.3 Test Equipment: Chemical test equipment is to consist of:

.1 An organic or phosphate test kit.

.2 An alkalinity and chloride dropper test kit.

3 EXECUTION

3.1 INSTALLATION

.1 Piping System Flushing And Cleaning:

.1 After new heat transfer system piping has been installed and leakage testing has been satisfactorily completed, but before mechanical equipment start-up and performance tests, flush and chemically clean the piping systems.

.2 Provide all required temporary piping connections, including bypass piping to isolate dirt sensitive mechanical plant equipment. Remove instrumentation such as flow meters and switches, orifice plates, meter valves and similar devices and plug pipe openings. Reinstall when flushing and cleaning work has been certified complete by the chemical manufacturer/installer. Ensure that control valves are operational and fully open during flushing and cleaning.

.3 Flushing Prior to Chemical Cleaning: Flush the piping, including dead ends, with water to remove loose solids. Clean all strainers. Replace chemical feeder line filters as required. Flush and drain until the water runs clear.

.4 Chemical Cleaning: When flushing with water is complete, fill the systems with fresh clean water. Meter the amount of water required to fill each system or otherwise calculate system capacity. Ensure that all air is vented from the systems. Add cleaning chemical as instructed by the chemical manufacturer and circulate the solution for a period of time and at a temperature as required to produce a clean piping system. Conduct daily pH, conductivity, and total iron tests in accordance with the chemical supplier's instructions.

.5 Flushing After Chemical Cleaning: When test results indicate a clean system, drain the solution from the piping, refill with clean water and circulate the water for a minimum of 24 hours to flush out remaining chemical solution, then drain the water from the piping using all drain points and again clean all system strainers and replace filters. Arrange for the chemical supplier to check each system after flushing and cleaning is complete and to certify in writing that flushing and cleaning procedures have been properly performed. Submit a copy of the certification letter. Fill the systems.

.2 Installation Of Open Heat Transfer System Treatment:

.1 Supply and feed into each system, sufficient chemical to charge the system to proper concentrations of chemical, and maintain proper levels in the system until Substantial Performance of the work.

.2 Arrange for the chemical supplier to check chemical levels in each system, to certify in writing that the feed equipment is properly installed and that water in each system is properly treated with chemical. Submit a copy of the certification letter.

.3 Hand test sets and spare chemicals to the Owner at the site. Store chemicals at the site where directed by the Owner.

.3 Manufacturer's Certification, Start-Up, And Training:

.1 For all water treatment equipment include for on-site certification, start-up supervision, and system training by the treatment chemical manufacturer's representative as follows:

.1 Equipment and system manufacturer's certification: refer to the article entitled Equipment and System Manufacturer's Certification in the Mechanical Work General Instructions Section.

.2 Start-up: refer to the article entitled Equipment and System Start-up in the Mechanical Work General Instructions Section.

.3 Demonstration and training: refer to the article entitled Equipment and System O & M Demonstration & Training in the Mechanical Work General Instructions Section. And include for 4 hours of on-site operation demonstration and training for 2 groups of 6 people.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

.1 Comply with the General Conditions of the Contract, the Supplementary Conditions, the General Requirements of Division 01 and Division 20.

1.2 SUMMARY

.1 Section includes: Provide standard ductwork

1.3 REFERENCES

.1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction

.1 American National Standards Institute (ANSI):

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

.2 American Society of Testing and Materials (ASTM):

.1 ASTM A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Coated (Galvannealed) by the Hot-Dip Process

.3 Underwriters Laboratories Canada (ULC):

.1 CAN/ULC-S110, Standard Methods of Test for Air Ducts

.2 CAN/ULC-S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

.4 National Fire Protection Association (NFPA):

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

1.4 SUBMITTALS

.1 Submittals under this Section shall be in accordance with General Conditions and Section 01 33 00.

.2 Product Data:

.1 Product Data: Submit product data sheets for all products specified in Part 2 of this Section except for duct and fittings.

.3 Test and Evaluation Reports:

.1 Duct Pressure Tests

2 PRODUCTS

2.1 MANUFACTURERS

.1 The products of the following manufacturers are acceptable subject to conformance with the requirements of the Drawings, Schedules and Specification:

.1 Acceptable Manufacturers:

.1 Flexible Ductwork

.1 Flexmaster

.2 Continental

.3 Wiremold

.2 Requests for substitutions shall be made in conformance with Section 01 25 00 – Substitution Procedures.

.3 Substitution Limitations:

.1 No further substitutions will be permitted.

.4 Single source responsibility: Obtain each type of piping specialty from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work. Products installed as part of the Work of this Section shall be from the same production run including all extra stock materials.

2.2 MATERIALS

.1 Galvanized Steel Ductwork:

.1 General: Galvanized steel sheet is to be hot dipped in accordance with requirements of ASTM A653. Galvanizing for bare uncovered duct to be finish painted is to be G60. All other galvanizing is to be G90.

.2 Rectangular: Lock forming grade hot dip galvanized steel, ASTM A653, shop fabricated, minimum #26 gauge.

.3 Round: Factory machine fabricated, spiral, mechanically locked flat seam, single wall duct, fittings and couplings.

.4 Flat Oval: Factory machine fabricated, single wall, 4-ply spiral lock seam duct, fittings and couplings.

.2 Metal Duct System Joint Sealant

.1 ULC listed and labelled, premium grade, grey colour, water base, non-flammable duct sealer, brush, or gun applied, with a CAN/ULC S102 maximum flame spread rating of 5 and smoke developed rating of 0.

3 EXECUTION

3.1 INSTALLATION

.1 Demolition:

.1 Do all required standard ductwork system demolition/revision work. Refer to demolition requirements specified in the mechanical work Section entitled Demolition and Revision Work.

.2 Fabrication And Installation Of Galvanized Steel Ductwork:

.1 Provide all required standard galvanized steel ductwork, rectangular and/or round and/or flat oval as shown. Note that where rectangular ductwork is shown, round or flat oval ductwork of equivalent cross-sectional area is acceptable.

.2 Duct Routing and Dimensions: Confirm the routing of all ductwork at the site and site measure ductwork prior to fabrication. Note that duct dimensions may be revised to suit site routing and building element requirements, if dimension revisions are reviewed with and approved by the Consultant. Duct routing and/or dimension revisions to suit conditions at the site are not grounds for a claim for an extra cost.

.3 Ducts Run Within or Through OWSJ: Refer to structural drawings. Where ductwork is to be run within or through open web steel joists, note that ductwork shown on the mechanical drawings is schematic only and is to be altered as required to suit the steel joist configuration, spacing, panel points, and cross-bridging at no additional cost.

.4 Ductwork Located at Sprayed Fireproofing: Wherever ductwork is required at locations where sprayed fireproofing is applied to building construction, install the ductwork only after the fireproofing work is complete and do not compromise the fire rating of the sprayed fireproofing.

.5 Automatic Control Components: Install (but do not connect) all duct system mounted automatic control components supplied as part of the automatic control work.

.6 Heat Transfer Equipment Connections: Where indicated, provide duct connections to fan powered heat transfer equipment with integral coils.

.7 Separate Hot Water Reheat Coils: Flange connect ductwork to hot water reheat coils in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible. The coils will be suspended independent of connecting ductwork as part of the heat transfer work.

.8 Rectangular Duct Support Inside Building: Support horizontal rectangular ducts inside the building in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, but use trapeze hangers with, unless otherwise specified, galvanized steel channels, and galvanized steel hanger rods for all ducts that are exposed, and all concealed ducts wider than 500 mm (20").

.9 Round and Flat Oval Duct Support Inside Building: Support round and flat oval ducts inside the building in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, but, unless otherwise specified, for both uninsulated and insulated ducts exposed in finished areas, use bands and secure at the top of the duct to a hanger rod, all similar to Ductmate Canada Ltd. type "BA". If the duct is insulated, size the strap to suit the diameter of the insulated duct.

.10 Flanged Duct Joints: Where flanged duct joints are used, do not locate the joints in wall or slab openings, or immediately at wall or slab openings. Do not use flanged joints for exposed uninsulated ducts in finished areas.

.11 Support of Roof Mounted Ducts: As specified in the mechanical work Section entitled Duct System Dampers and Accessories.

.12 Watertight Ductwork: Where watertight horizontal ductwork is required, construct the ducts without bottom longitudinal seams. Solder or weld the joints of bottom and side sheets. Seal all other joints with duct sealer. Slope horizontal duct to hoods, risers, or drain points. Provide the drain points. Provide watertight ductwork for:

.1 All galvanized steel ductwork outside the building or otherwise exposed to the elements.

.2 Fresh air intakes.

.3 Wherever else shown or specified.

.13 Application of Sealants: Apply sealants by brush or gun to cleaned metal surfaces. Where bare ductwork is exposed apply neat uniform lines of sealant. Randomly brushed, sloppy looking sealant applications will be rejected and must be repaired or replaced with a neat application of the sealant.

.14 Protective Coating for Exposed Exterior Ducts: Clean exterior exposed (uninsulated) ducts with a heavy full coverage of black metal paint equal to Bakor #410-02.

.15 Connection of Dissimilar Metal Ducts: Where dissimilar metal ducts are to be connected, isolate the ducts by means of flexible duct connection material as specified in the Section entitled Duct System Dampers and Accessories.

.3 Duct System Protection, Cleaning And Start-Up:

.1 Temporarily cover all open ends of new ducts during construction.

.2 Vacuum all dirt and foreign matter from the entire duct systems and clean duct system terminals and the interior of air handling units prior to operating fans.

.3 Prior to starting any supply air handling system provide 50 mm (2") thick glass fibre construction filters at fan equipment in place of permanent filters.

.4 Provide cheesecloth over all duct system inlets and outlets and run the system for twenty-four hours, after which remove the cheesecloth, the construction filters, and install new permanent filters.

.5 Include all labour for a complete site walk-through with testing and balancing personnel following the route of all duct systems to be tested, adjusted and balanced for the purpose of confirming the proper position and attitude of dampers, the location of pitot tube openings, and any other work affecting the testing and balancing procedures. Perform all corrective work required as a result of this walk-through.

.4 Testing, Adjusting And Balancing:

.1 When work is complete and equipment is operating as intended, test, adjust and balance air flows and temperatures in accordance with requirements specified in the mechanical work Section entitled Testing, Adjusting, and Balancing.

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

.1 Closed-circuit, forced-draft, counter-flow cooling towers with hybrid operation.

1.2 REFERENCE STANDARDS

.1 ASME B31.5 - Refrigeration Piping and Heat Transfer Components 2016.

.2 ASME Section VIII Boiler and Pressure Vessel Code

.3 ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus 2018.

.4 ASHRAE Standard 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings

.5 CTI ATC-105 - Acceptance Test Code 2000.

.6 CTI STD-201 OM - Operations Manual for Thermal Performance Certification of Evaporative Heat Rejection Equipment 2017.

.7 CTI STD-201 RS - Performance Rating of Evaporative Heat Rejection Equipment 2017.

.8 ISO 9001 - Quality management systems -- Requirements 2015.

.9 NEMA MG 1 - Motors and Generators 2017.

1.3 SUBMITTALS

.1 Product Data: Provide rated capacities, dimensions, weights and point loadings, accessories, required clearances, electrical requirements and wiring diagrams, and location and size of field connections.

.2 Shop Drawings: Indicate suggested structural steel supports including dimensions, sizes, and locations for mounting bolt holes.

.3 Manufacturer's Certificate: Certify that cooling tower performance, based on CTI STD-201 meets or exceeds specified requirements and submit performance curve plotting leaving water temperature against wet bulb temperature.

.4 Manufacturer's Instructions: Submit manufacturer's complete installation instructions.

.5 Operation and Maintenance Data: Include start-up instructions, maintenance data, parts lists, controls, and accessories.

.6 Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum twenty years of documented experience and ISO 9001 certification.

.2 Installer Qualifications: Company specializing in performing the type of work specified in this section with minimum 3 years of experience installing cooling towers.

.3 The Evaporative Heat Rejection Equipment shall comply with the energy efficiency requirements of ASHRAE Standard 90.1.

1.5 REGULATORY REQUIREMENTS

.1 Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 For shipping – all 3 modules as well as the discharge hood and piping headers will ship loose for field installation by others so that they are small enough to be dropped in through the existing roof opening for existing fluid cooler discharge. Installing contractor to ensure that the largest module (i.e. module # 1 with the control panel – refer to shop drawings) can fit through the roof opening.

.2 Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

1.7 WARRANTY

.1 One year warranty after start up, or eighteen months from date of shipment, whichever occurs first. Warranty to include coverage for defects in material and workmanship.

.2 Fans, fan motors, variable speed controller, bearings, sheaves, drive shafts, gears, couplings, and mechanical equipment support must be warranted against defects in materials and workmanship for a period of five (5) years.

2 PRODUCTS

2.1 MANUFACTURERS

.1 Basis of Design: Baltimore Aircoil Company

.2 Closed-Circuit, Forced-Draft, Counter-Flow Cooling Towers with Hybrid Operation:

.1 Baltimore Aircoil Company; Nexus Modular Hybrid Cooler: www.baltimoreaircoil.com

2.2 MANUFACTURED UNITS

.1 Provide a modular hybrid, forced draft counterflow cooler. It must be provided with a full controls package that provides modes to optimize water and energy savings, and eliminate any potential for spray water system freezing in cold weather climates. The entire unit and controls package shall be factory-wired and tested. The controls will be integral to the unit operation with single point power connection.

2.3 COMPONENTS

.1 Cold Water Basin:

.1 Provide type 304 stainless steel basin with drain/clean-out connection. Basins constructed of 301 stainless steel are not acceptable.

.1 The spray water collection basin and all of its components and accessories will be fully accessible while the unit is in operation. Proper lockout-tagout procedures must be followed when servicing electrical components. The cold water basin is to be located at work bench height from base of unit to facilitate easy inspection and maintenance.

.2 Basin will allow no spray water to be exposed to sunlight.

.2 Provide factory-installed collection basin accessories:

.1 Pan Strainer(s) will be all Type 304 Stainless Steel construction with large area removable perforated screens.

.2 Type 304 Stainless Steel Overflow connection

.3 Factory-wired and installed motorized large orifice drain valve

.4 Factory-wired and installed motorized make-up control water valves and Type 304 stainless steel connection

.5 Factory-wired and installed stainless steel high and low level alarms

.6 Factory-wired and installed water conductivity sensor

.7 304 Stainless steel threaded connection for water treatment system.

.3 Provide a sloped collection basin that provides continuous turbulence of the water. A factory-supplied solids separator and factory-installed basin sweeper piping system is an acceptable alternative for alternative manufacturers but is not required for BAC NEXUS units.

.2 Casing Panels and Framework:

.1 Casing panels: Galvanized steel protected by a thermosetting hybrid polymer. The polymer to consist of G-235 (Z700 metric) hot-dip galvanized steel prepared in a four-step (clean, pre-treat, rinse, and dry) process with an electrostatically applied, thermosetting, hybrid polymer fuse-bonded to the substrate during a thermally activated curing stage and monitored by a 23-step quality assurance program. Other coatings must be submitted to the engineer for pre-approval. Approved equals must have undergone testing, resulting in the following results as a minimum:

.1 When X-scribed to the steel substrate, unit to withstand 6000 hours of 5 percent salt spray per ASTM B117 without blistering, chipping, or loss of adhesion.

.2 When X-scribed to the steel substrate, unit to withstand 6000 hours of exposure to acidic (pH=4.0) and alkaline (pH=11.0) water solutions at 95 degrees F (35 degrees C) without signs of chemical attack.

.3 Unit to withstand impact of 160 in-lbs per ASTM D2794 without fracture or delamination of the polymer layer.

.4 Unit to withstand 6000 hours of ultraviolet radiation equivalent to 120,000 hours of noontime sun exposure without loss of functional properties.

.5 Unit to withstand 200 thermal shock cycles between minus 25 degrees F and 180 degrees F (minus 32 degrees C and 82 degrees C) without loss of adhesion or other deterioration.

.6 Unit to withstand 6000 hours of exposure to 60 psi (42,184 kg/m^2) water jet without signs of wear or erosion.

.7 Type 304 stainless steel construction shall be supplied by alternative manufacturers as an equal to eliminate the need for passivation, minimize maintenance requirements, and prolong equipment life.

.3 Fans: Epoxy coated aluminum, radial type, with electronically commutated direct drive motors.

.1 Fan Coating: Comply with DIN EN 485-2.

.2 Factory installed and located outside of the wet airstream in the unit.

.3 Fan(s) must be constructed of an aluminum alloy designed to meet or exceed standard DIN EN 485-2, protected with an epoxy coating.

.4 Fan(s) must be both statically and dynamically balanced to provide for vibration-free performance.

.5 Provide fan plenum design with swing-out fan base with stainless steel hinge that allows for access and easy removal. For units alternative manufacturers unit with fans at the top of the unit, a davit assembly is to be provided for fan and motor maintenance and removal.

.6 Balancing: Fans will have maximum residual balance as per DIN ISO 1940.

.4 Motors and Drives:

.1 Direct Drive System:

.1 Electronically Commutated (EC) Drive system: Type F insulation with IP55 ingress protection. Full load efficiency of at least 91 percent, maintenance-free, permanently lubricated ball bearings, integrated thermal overload protection, PFC filter complying with IEC 61000-3-2, and integrated phase loss protection.

.5 Fan Guard: 304 Stainless steel wire mesh guards to prevent injury while fan is in operation.

.6 Heat Transfer System:

.1 Closed Circuit Heat Exchanger:

.1 The heat exchanger will be constructed of a highly corrosion-resistant stainless steel alloy that exceeds accelerated cyclic corrosion test standard GMW14872. Type 316 stainless steel can be provided as equivalent.

.1 No field passivation required.

.2 Maximum allowable working pressure of 150 psi and tested according to UL1995.

.3 The heat exchanger shall provide a minimum efficiency of 1.0 nominal ton per 1.5 gallons of internal working fluid volume.

.4 Internal heat exchanger volume must not exceed volume listed on equipment schedule.

.7 Distribution Section: Polyvinyl chloride piping header and branches with ABS plastic spray nozzles.

.8 Drift Eliminators: Three pass PVC, drift loss limited to maximum of 0.005 percent of total water circulated.

.9 Basin Water Level Control: PVC, balanced piston type make-up valve with plastic float.

.10 Electronic Water Level Alarms: Must monitor and notify both high and low water levels. High and low alarm contacts included.

.11 Hardware: Stainless steel nuts, bolts, washers, and tappers; assembled with phenolic epoxy coated, corrosion resistant washer head fasteners.

2.4 PERFORMANCE REQUIREMENTS

.1 This section is based on specific selections of equipment, and these selections relate to selection of related equipment. In substituting equipment, ensure that performance selection criteria matches that specified or that the selection of related equipment is acceptable or is revised to suit.

.2 Capacity:

.1 Water Flow: 293 USGPM.

.2 Entering Water Temperature: 102 degrees F.

.3 Leaving Water Temperature: 92 degrees F.

.4 Entering Air WB Temperature: 76 degrees F.

.3 External Static Pressure: 0.5 inches wg.

.4 Electrical Characteristics:

.1 Quantity of three (3) 5 HP fans.

.2 Quantity of three (3) 0.5 HP spray pumps.

.3 Disconnect Switch: Factory mount disconnect switch in control panel.

2.5 ACCESSORIES

.1 Water and Energy Conservation Control System: The closed circuit cooler control system will control all motor driven and optional electrically operated equipment including (but not limited to) the fan motors, spray pump motors, basin heaters, conductivity controller, make-up and drain valve, and manufacturer supplied water level switches. The operation of all driven components must be manually overridden for equipment startup or troubleshooting. The status of all equipment must be available to be displayed on a panel mounted user interface.

.1 Design Requirements

.1 The control panel manufacturer shall be listed by Underwriters Laboratories as an approved manufacturer of industrial control panels. Use of commercial grade controllers from the building automation contractor shall not be acceptable.

.2 The control panel enclosure shall meet NEMA 4x requirements.

.2 Control Panel will include the following components:

.1 Local control only, no interface with building management system.

.2 Programmable Logic Controller (PLC) with 15 percent spare I/O terminals

.3 Fluid Outlet Temperature Sensor.

.4 Ambient Dry Bulb Sensor.

.5 Spray Pump Motor Starters.

.6 Main Circuit Breaker Disconnect

.7 Control Power Transformer

.8 High Basin Water Level Alarm Contact.

.1 Low Basin Water Level Alarm Contact.

.2 Relays, Fuses and Circuit Breakers for All Unit Equipment

.3 UI Screen

.4 Remote Access Device with cellular communication capability.

.5 Relays

.1 Relays shall be of the plug-in base or terminal block type. Relays shall be rated for continuous duty operation.

.6 User Interface (UI)

.1 Provide operator display as a stand-alone component with a separate programmable logic controller. Use of a computer for the process control will not be acceptable.

.2 The UI must be provided with a weather-tight cover mounted on the door of a NEMA 4 enclosure such that it will maintain the enclosure's NEMA 4 rating.

.3 The UI shall be industrially rated and certified for the following conditions:

.1 Relative Humidity: 5 to 95% (Non-condensing)

.2 UI shall be rated for 50,000 hours of life

.3 The UI shall be industrially rated and certified for UL/ULC.

.3 Operation

.1 The closed circuit cooler manufacturer shall furnish a description of the sequence of operation for the provided control system.

.2 For all supported modes of operation, the panel shall utilize adaptive logic to allow for automatic adjustment between unit modes of operation based on real time system load and ambient temperature conditions.

.3 Each unit shall be able to switch between the following unit modes of operation based on the customer set unit priority:

.1 Energy Saving Mode – In this mode, the modular hybrid cooler shall operate with the basin water circulation pump(s) energized and the fan motor(s) running. The fan speed will be modulated based on real time leaving water temperature and ambient conditions for maximum energy efficiency.

.2 Water Saver Mode – In Water Saver Mode, the modular hybrid cooler shall operate with the basin water circulation pump(s) de-energized and the fan motor(s) running. The fan speed shall be modulated based on real time leaving water temperature and ambient conditions for maximum water efficiency.

.3 Balanced Water and Energy Saving Mode – In this mode, the individual modules will operate wet (circulating pump energized) or dry (circulating pump de-energized) depending on the customer's setting:

.1 Customer Priority Setting – While maintaining the desired process supply water temperature, the control system will automatically operate separate modules either wet or dry based on an integral sliding scale in the controls logic. The customer will have the ability to adjust their priority of energy or water savings by choosing a value on the sliding scale.

.4 The unit controller shall have the ability to communicate with building automation system via BACnet/IP BAS communication protocol

.5 Installation

.1 All wiring to the control panel shall be installed by a licensed electrician. The National Electrical Code and all applicable state and local codes shall be followed when installing this equipment. All power, control and sensor field wiring between the control panel and the closed circuit cooler must be provided by others. **As the main power supply to the unit will be 460/3/60, it MUST be a WYE connected power source, see the unit wiring diagram.**

.2 Control panel enclosure must be mounted to the closed circuit cooler. Separate brackets or stands are not acceptable.

.4 The cold water collection basin and all of its components and accessories will be fully accessible while the unit is in operation. Proper lockout-tagout procedures must be followed when servicing electrical components. The cold water basin is to be located at work bench height from base of unit to facilitate easy inspection and maintenance.

.1 Drift eliminators will be accessible and removable from the side of the unit and will not require any fixed access platforms or ladders from the base of the unit. Units that require drift eliminators to be removed from the top of the unit shall include access platforms, handrails, and ladders to facilitate maintenance of the drift eliminators.

.2 External Process Fluid Piping on multi-module units:

.1 Provide stainless steel modular header assembly for all coil connections to allow for a single inlet and outlet connection for process fluid piping. Headers shall be designed to allow for expected thermal expansion and contraction, while allowing for field misalignment. Headers ship loose for field installation by others.

.3 Vibration Isolation:

.1 Fluid cooler supplier shall provide 2” deflection vibration isolation rails with a zinc-rich epoxy coating. These ship LTL to the job site or the installing contractors ship which is the suggested ship to method given that they ship LTL.

.4 Discharge Hood:

.1 The unit shall ship complete with a tapered discharge hood complete with positive closure dampers and actuator.

3 EXECUTION

3.1 INSTALLATION

.1 Install in accordance with manufacturer's instructions.

.2 The NEXUS modules must sit on top of the continuous support as per the support drawings included in the shop drawings. Steel beams are by others. Refer to the support drawing provided as part of the submittal.

.1 Connect condenser water piping with flanged connections to tower. Pitch condenser water supply to tower and condenser water suction away from tower. Refer to Section 232113.

.2 Connect make-up water piping to the unit. Pitch to tower. Refer to Section 221005.

.3 Connect overflow, bleed, and drain to floor drain.

3.2 FIELD QUALITY CONTROL

.1 See Section 014000 - Quality Requirements, for additional requirements.

.2 Provide the services of the manufacturer's field representative to inspect tower after installation and submit report prior to start-up, verifying installation is in accordance with specifications and manufacturer's recommendations.

3.3 SYSTEM STARTUP

.1 Start-up tower in presence of and instruct Owner 's operating personnel.

3.4 SCHEDULES

.1 Cooling Towers

.1 Location: Built up room withing existing mechanical penthouse.

.2 Manufacturer: BAC

.3 Model Number: NXF-0403N-CS2TS-H3

.4 Cooling Capacity

.1 Water Flow Rate: 293 USGPM

.2 Entering Water Temperature: 102F

.3 Leaving Water Temperature: 92F

.5 Entering Air WB Temperature: 76F

.6 External Static Pressure: 0.5”

3.5 SOUND DATA

.1 Sound data shall not exceed the following:

Model Information

Product Line: Nexus™ Modular Hybrid Cooler
Model: NXF-0403N-CS2TS-H3
Number of Units: 1
Fan Type: Standard Fan
Fan Motor: (3) 5.00 = 15.00 HP/Unit
Total Standard Fan Power: 98.30% of Full Speed, 14.25 BHP/Unit
Total Pump Motor Power: (3) 0.50 = 1.50 HP/Unit
Heat Exchanger Type: hCore™ Heat Transfer Technology
Intake Option: None
Internal or Const. Option: None
Discharge Option: PCD w/ Tapered Discharge Hood
External Static Pressure: 0.5 in. of H2O

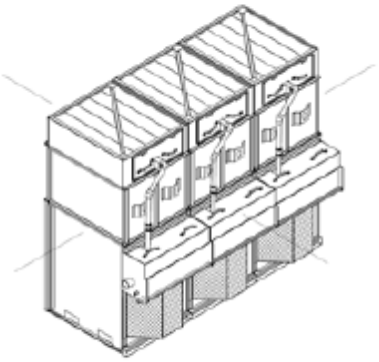
Octave band and A-weighted sound pressure levels (Lp) are expressed in decibels (dB) reference 0.0002 microbar. Sound power levels (Lw) are expressed in decibels (dB) reference one picowatt. Octave band 1 has a center frequency of 63 Hertz.

Top Lp
Sound Pressure (dB)

Octave Band	Distance 5 ft.	Distance 50 ft.
1	72	62
2	73	64
3	74	59
4	69	54
5	69	51
6	67	50
7	66	47
8	64	42
A-wgtd	**75**	**58**

End Opp. Sump
Sound Pressure (dB)

Octave Band	Distance 5 ft.	Distance 50 ft.
1	73	67
2	77	63
3	71	56
4	66	54
5	61	51
6	53	43
7	52	45
8	45	38
A-wgtd	**68**	**56**



Right Side
Sound Pressure (dB)

Octave Band	Distance 5 ft.	Distance 50 ft.
1	69	62
2	78	67
3	70	58
4	65	56
5	62	52
6	56	48
7	57	51
8	47	42
A-wgtd	**68**	**59**

Left Side
Sound Pressure (dB)

Octave Band	Distance 5 ft.	Distance 50 ft.
1	69	62
2	78	67
3	70	58
4	65	56
5	62	52
6	56	48
7	57	51
8	47	42
A-wgtd	**68**	**59**

Sump End
Sound Pressure (dB)

Octave Band	Distance 5 ft.	Distance 50 ft.
1	75	63
2	84	69
3	71	65
4	73	59
5	73	57
6	72	53
7	69	59
8	64	50
A-wgtd	**78**	**65**

Sound Power (dB)

Octave Band	Center Frequency (Hertz)	Lw
1	63	95
2	125	97
3	250	92
4	500	87
5	1000	84
6	2000	82
7	4000	82
8	8000	75
A-wgtd		**91**

Extra Notes: Sound data provided by CTI ATC-128 sound test code revision 2019

END OF SECTION

1 GENERAL

1.1 INSTRUCTIONS

.1 Comply with the General Conditions of the Contract, the Supplementary Conditions, and Division 01 – General Requirements.

1.2 SUMMARY

.1 This Section specifies requirements and instructions that are common to electrical work Sections of the Specification, and it is a supplement to each Section and is to be read accordingly.

.1 Provide all wiring, conduit, materials, equipment, test/commissioning etc., shown or required to complete the electrical work unless otherwise specified. Any item or system which is shown, mentioned or reasonably implied on either the drawings or in the specifications shall be considered to be properly and sufficiently specified and shown, and must be provided. Include all labour, equipment, tools, etc., required to complete all installations as intended. Install all equipment according to the method indicated, manufacturer's instructions or according to standard industry practices if no installation technique is defined.

.2 Refer to Division 01 - General Requirements for specific instructions regarding staging of work and requirements for work in partially occupied areas. All work performed in an area which is to be partially occupied during construction is to be provided in co-ordination with other trades to minimize disturbance of the occupants and in accordance with the Contractor’s instructions.

1.3 REFERENCES

.1 Reference Standards: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section. Where regulatory requirements use older version of a standard, comply with the version year adopted by the Authority Having Jurisdiction. Materials supplied to conform to minimum published requirements and recommendations, or better, of applicable standards of:

.1 CSA - Canadian Standards Association

.2 EEMAC - Electrical and Electronic Manufacturers' Association of Canada

.3 ULC - Underwriters Laboratories of Canada Ltd.

.4 NEMA - National Electrical Manufacturers' Association

.2 Provide all materials and work in accordance with the latest editions of the Electrical Code, the Building Code, applicable CSA and ULC Standards, the Requirements of the Electrical Authority and all other applicable Municipal and Provincial Codes and Regulations. Any materials, equipment or installations not meeting all requirements of the appropriate regulatory agencies will not be accepted. Ensure these requirements are met and provide evidence of such as requested.

.1 Electrical Authority - Electrical Safety Authority

.2 Building Code - Ontario Building Code

.3 Electrical Code - Ontario Electrical Safety Code

1.4 ADMINISTRATIVE REQUIREMENTS

.1 Determine the full scope of work by referring to all drawings and specifications.

.2 It is the intent of these Specifications and Drawings, to provide sufficient information and details for construction of a complete and operational electrical installation.

.3 Any item or subject which is shown, mentioned or reasonably implied on either drawings or in the specifications, is considered to be properly and sufficiently specified and shown; and must be provided. Provide all labour equipment tools, etc. required to complete all the work of this division.

.4 Forward to the Consultant all correspondence and instructions from the Electrical Authority for clarification and action.

.5 Arrange and pay for all permits and inspections by authorities having jurisdiction, required in undertaking of work under this Division. Modifications required by the above stated authorities to be made without any additional charge to the Owner.

.6 Carry proper and adequate liability insurance to protect both himself and the Owner from all claims related to his work for this project.

.7 Perform all work in such a manner as to cause as little disturbance or inconvenience as possible to the existing operations. Where deemed necessary by the Owner or Consultant/Project Manager, provide temporary measures as required to maintain specific services and/or provide work outside regular hours at no additional cost. Do not interrupt any electrical services without prior authorization.

.8 It is the intention of the Owner to enter into an equitable contract with this Division. Having done so, it is the expectation of the Owner that the work of this Division will be carried out with the utmost precision and care. The standards of work quality and layout and organization of the installations as listed herein shall be strictly adhered to. Any work deemed unacceptable by the Consultant shall be removed and replaced at no additional cost to the Owner.

.9 Conform to minimum requirements or better of provincial and local codes, where existing, and to requirements of local inspection authorities for execution of work under this Division.

.10 Plan work well in advance to eliminate delivery and installation difficulties. Co-ordinate work with other trades to prevent conflicts on site and resolve interferences. Provide work in stages and at times required by the project schedule.

.11 Drawings

.1 Drawings are diagrammatic and show the required distribution, number and locations of the electrical equipment, fixtures and outlets, and indicate suggested circuiting. Do not scale drawings but use only dimensions which are shown. Where exact building dimensions and details are required, use only dimensions from the Architectural Drawings or job site dimensions. Assemble reviewed shop drawings and operating and maintenance information into electronic files complete with table of contents and submit to the Consultant/Project Manager following completion of the project. Indicate in red on as-built drawings all deviations and approved changes from the Contract Drawings.

.12 Coordination:

.1 In general, provide all power supply wiring, line voltage control wiring and Electrical Code required disconnect switches for any equipment installed by other trades. Verify the electrical characteristics and wiring requirements of all equipment before proceeding with the actual installations. Refer to the drawings for a description of equipment wiring and control requirements and components to be provided.

.2 Co-operate with all other trades on the job such that all equipment can be installed without any conflicts or delays. Provide and maintain temporary wiring, lighting and power supply installations as required by other trades during construction.

.3 Power Interruptions

.1 Keep service and distribution system power interruptions to a minimum. Coordinate power interruptions with the Owner and all other Trades. Submit written application for electrical interruptions indicating the date, time, and estimated duration of the interruption to the Owners and Consultant/Project Manager at least two weeks prior to the requested shutdown date. Do not proceed with shutdown without written approval from Owner.

.2 The Electrical Drawings do not generally show any Structural or Architectural details. Take any information involving accurate measurements of the building and site from the dimensional drawings.

.3 Dimensioned details and elevations generally take precedence over other conflicting details. However, where a conflict exists, clarify before starting installation. Make changes required to equipment or the installation, due to the Architectural or Structural details, without additional charges or expense to the Owner.

1.5 SUBMITTALS

.1 Product Data/Shop Drawings:

.1 Submit for review shop drawings and data sheets in PDF format covering all items or equipment to be installed under the Contract. Show all relevant performance and installation information on shop drawings or product data sheets. Submit reviewed shop drawings and product data to other trades as required for completion of their related work.

.1 Distribution and control equipment

.2 Equipment will not be accepted on site until review of shop drawings is complete.

1.6 CLOSEOUT SUBMITTALS

.1 Maintenance and Instruction Manual

.1 Provide digital Maintenance and Instruction Manuals at the completion of the project complete with table of contents and information sheets and subdivided into appropriate and identified file folders/bookmarks. Each manual shall contain, but not be restricted to, the following information:

.1 each shop drawing or product data (revised as per the reviewed drawings).

.2 equipment parts list.

.3 recommended list of spare parts.

.4 operating and maintenance instructions.

.5 equipment installation details, construction, and performance data.

.6 all manufacturing and equipment service depots including telephone numbers.

.7 Electrical Authority final inspection certificate.

.8 emergency lighting test results

.9 fire alarm verification certificate

.10 fire alarm audibility testing reports

.11 telecommunications cabling test results

.12 any other extended warranties, certificates, approval letters, etc.

.2 Instruct the Owner's Representatives in the operation and maintenance of the systems and equipment included in this division by qualified technicians.

.3 As-built Drawings:

.1 Always keep a complete and separate set of prints on site and note thereon clearly, neatly, accurately, and promptly all Civil, Architectural, Structural, Mechanical and Electrical changes, revisions and additions to the work and deviations from the Contract Documents. Include accurate locations, depth, size, and type of underground utilities in these as-built drawings.

.2 Indicate also on the as-built drawings the location of access panels or removable ceiling tiles which cover equipment or junction boxes which may require future access or where conduit or wiring for future use is located.

.3 Prepare the final as-built drawings by a qualified draftsperson in AutoCAD at this trade's expense in both DWG and PDF formats to be submitted to the Consultant/Project Manager at the completion of the project with an application for a Certificate of Total Performance.

1.7 WARRANTY

.1 Manufacturer Warranty:

.1 Guaranty all materials and installations of this division for a period of one year from the date of final acceptance of the work unless otherwise specified, regardless of the extent of equipment manufacturer's warranties. Arrange with each manufacturer/supplier to extend warranties as necessary to coincide with warranty period or those periods specified.

.2 Make submissions necessary to register product warranties to the benefit of the Owner.

2 PRODUCTS

2.1 MATERIALS

.1 Install all items approved by a certification organization accredited by the Electrical Authority (CSA, ULC, etc.) or field approved for the application by the Electrical Authority or an accredited certification organization. All work and installations to be acceptable to the equipment manufacturer or system supplier and be approved by the Electrical Authority. All materials specified with manufacturer's name, type, bulletin number, etc., are to establish type and quality of materials required and first choice of manufacturer. Equivalent materials by other manufacturers may be used, but only after obtaining approval from the Consultant. Unless otherwise indicated, supply new equipment and materials.

.2 Generally, mount equipment as close as practical to the location shown on the drawings taking into consideration site conditions. Ensure all equipment is located in a manner allowing easy access for maintenance, repair or adjustment. Confirm all architectural conditions such as glazing, door swings, furniture, and equipment types and layouts, on site prior to installing any related item or wiring.

.3 The Consultant reserves the right to relocate any fixture, outlet, device, equipment, etc., up to 3 m (10 ft) prior to installation without incurring any extra cost. Confirm locations, mounting height and arrangement of all outlets on site prior to installation.

.4 Conduit systems

.1 Supply conduit for conductors except armoured cable, mineral insulated cable, and except where cable tray, cable duct, or a similar raceway is used.

.2 Conduit for main distribution wiring in electrical rooms and similar areas, exposed conduit from floor level to 1.2 m (4 in) above the floor in mechanical and other service rooms, concealed conduit in exterior walls, and exposed outside the building, except where rigid PVC conduit is permitted – rigid galvanized steel to CSA C22.2 No. 45.

.3 Conduit at points where exposed conduit crosses building expansion joints – galvanized steel flexible conduit to CSA C22.2 No. 56, complete with proper and suitable squeeze type connectors at terminations.

.4 Conduit for branch circuit conductors underground inside the building and underground outside the building beneath structures and concrete or asphalt paving, for branch circuit conductors outside the building at roof level, for branch circuit conductors in concrete slabs on grade, and in concrete and masonry walls except exterior walls – rigid PVC conduit to CSA C22.2 No. 211.1, complete with solvent weld joints, factory made expansion joints where required, and terminations made with proper and suitable connectors and adaptors.

.5 Conduit for all conduit except as specified above – EMT to CSA C22.2 No. 83, complete with joints and terminations made with steel couplings and set screw type connectors, concrete tight where required.

.6 Conduit fittings are to be of the same material as the conduit. Generally, conduit is sized on the drawings. Conduit not sized on the drawings is to be sized in accordance with the governing Codes/Regulations. Do not use conduit less than 13 mm (½ in) diameter.

.5 Line voltage conductors

.1 Supply copper, colour coded and factory identified conductors. Conductors to and including 10 AWG are to be solid or stranded. Conductors larger than 10 AWG are to be stranded. Minimum size 12 AWG, sized and colour coded according to the Electrical Code where not indicated.

.2 Non-fire rated conductors are to be as follows:

.1 conductors underground inside or outside the building, and in non-climate controlled areas – RWU-90 single conductor in accordance with CSA C22.2 No. 75, PVC insulated

.2 conductors in accessible ceiling spaces, within stud wall construction, and in furniture systems to luminaries and wiring devices – AC90 (BX) flexible armoured cable to CSA C22.2 No. 51, maximum 4 m (12 ft) run permitted and be suitably clipped and supported every 900 mm (3 ft).

.3 for conductors except as specified above or elsewhere in the Specification or on drawings – RW90 single conductor in accordance with CAN/CSA C22.2 No. 38, 90°, X-link polyethylene insulated. T90 nylon may be used in lieu of RW90 for interior installations up to size 10 AWG, however, conduit fill shall be based on RW90 rating.

.3 Fire rated conductors are to be Tyco/Pyrotenax Mineral Insulated (MI) ULC 2-hour fire rated conductor in accordance with CSA C22.2 No. 124, Supply fire rated conductors for service as required by Building Code.

.4 Aluminium Sheath Cable: Provide bare aluminium sheath cable where shown/specified. Cable is to be Nexans “Corflex” II” RA90 flexible cable in accordance with requirements of CSA C22.2 No. 123, or “Firex II” TECK 90 cable in accordance with requirements of CSA C22.2 No. 131. Install in accordance with the manufacturer’s instructions, including the following requirements:

.1 support and secure overhead suspended multiple cables on a system of cable tray, and secure individual cables directly to building surfaces by means of single screw non-ferrous clamps

.2 ground and bond single conductor cable at both ends where the sheath currents do not affect the cable ampacity, and for certain areas, where the sheath currents will reduce the cable ampacity, ground and bond the cable at the supply end and isolate the cable at the load end as recommended by the cable manufacturer, and supply a 3/0 AWG green RW-90 ground conductor for each cable, all as per Section 10 of the Electrical Code

.3 terminate cable with lugs and termination kits supplied with the cable

.5 Conductor Sizing: Generally, conductor sizes are indicated on the drawings. Unless otherwise specified, do not use conductors smaller than 12 AWG in systems over 30 volts. Unless otherwise specified, do not use conductors smaller than 6 AWG for exterior luminaire wiring. Conductor sizes indicated on the drawings are minimum sizes and must be increased, where required, to suit length of run and voltage drop (2% for feeders, 3% for branch). All branch circuit wire feeding a 20 A protected lighting circuit shall be minimum 10 AWG wire. All branch circuit wiring feeding a 15 A protected circuit which is over 50 m (150 ft) in length shall be minimum 10 AWG wire. All 120 V (single phase) branch circuits shall be supplied with a separate neutral conductor for each circuit.

.6 Conductor Colour Coding: Colour code conductors to identify phases, neutral, and ground by means of self-laminating coloured vinyl tape, coloured conductor insulation, or properly coloured plastic discs. Colours are to be phase A - red, phase B - black, phase C - blue, identified (neutral) - white, Bond – Green, and control - orange.

.6 Low voltage (24 volt) conductors

.1 Unless otherwise specified, supply T-90 or RW90 stranded copper conductors in conduit as specified above, for low voltage wiring.

.2 For fire alarm signal wiring, security system and communication system wiring in conduit, provide conductors equal to Nexans “Securex II” FAS/LVT/FT1300 volt wire to CSA C22.2 No. 208, and if required for the application, interlocking aluminium armour with or without an overall jacket.

.7 Grounding and bonding

.1 Do all required grounding and bonding work. Supply a green insulated ground conductor in every raceway, sized in accordance with the Electrical Code and CSA C22.2 No. 41, or, for health care projects, in accordance with CAN/CSA Z32.

.2 Use exothermic welds or compression connectors for underground conductor connections. Use 2-hole compression type copper lugs for connections to ground bus.

.3 For natural gas service piping provide a 6 AWG green insulated ground conductor installed in accordance with the Electrical Code the Gas Utilization Code.

.4 Grounding bus bars to be tin-plated copper with multiple standard spacing for 2-hole lugs.

.8 Distribution and control equipment

.1 Alter and extend the existing electrical distribution system as shown on the drawings to meet the requirements of the project. Provide all new distribution equipment and wiring indicated. Refer to the power distribution schematic and associated schematics for further details.

.2 <01Panelboards: Dead front, factory assembled, designed for sequence phase connection of branch circuit devices, in accordance with CAN/CSA- C22.2 No. 29. Comply with Electrical Code Rule 14-014 with regards to series rated combinations of over-current protective devices and ensure that equipment in which the lower rated devices are installed are marked with a series combination interrupting rating at least equal to the available fault current. Each panelboard is to be complete with silver plated, electrical grade, 95% conductivity copper bus mains, a removable cover for main lugs, an EEMAC 2 enclosure equipped with, for panelboards in areas other than secure Electrical Rooms, a concealed hinged door and flush latch with keyed alike lock, and circuit breakers or fused switches (as scheduled) as per CSA-C22.2 No. 5, and for dedicated breakers, handle lock devices. Acceptable manufacturers are Eaton, Schneider Electric, and Siemens Electric.

.1 Branch Circuit Panelboards: Breaker type branch circuit panelboards are to be complete with double neutral, main and branch circuit conductor solderless set-screw type lugs approved for copper conductors, and Mylar circuit breaker identification strips secured in place.

.3 Panels shall be of the type with voltage and current rating as shown on the drawings, sized to accommodate branch circuit breakers and spaces as indicated. Bus bracing shall be provided to suit the short circuit capacity rating indicated on the drawings or minimum 10 kA at 208 V, 3 phase or 14 kA at 600 V, 3 phase as applicable. Restrictive dimensions shall be as shown. Supply locking doors for all panels. Supply all panel doors, trim and surface mount tubs in a light gray enamel paint. Supply galvanized tubs for flush mount panels.

.4 Unless otherwise noted all breakers shall be rated minimum 14 kA symmetrical interrupting capacity at 600 volts, 3 phase or 10 kA symmetrical interrupting capacity at 208 volts, 3 phase as appropriate and not less than the short circuit capacity as shown on single line diagram drawings.

.5 Supply breaker lock-on devices for all essential and emergency loads. Connect all single-phase loads such that there is the least possible imbalance of phases under normal conditions. Supply panel labels and a neatly printed and appropriately labelled directory card for each panelboard.

.6 Disconnect switches: heavy duty type with visible blades in the off position, quick- make quick-break operating mechanism, lock-off provision, door/handle interlock with override and shall be horsepower and electric heat rated. Switch fuse holders shall have reinforced clips. Fuses shall be easily removable when the switch is in the off position. All switches shall have ample gutter space for top or bottom wiring and be provided with enclosures to suit the specific application.

.7 Supply manual and magnetic motor starters for motors and equipment as indicated. Starters to include manual reset, adjustable thermal overload units with integral single phase protection and at minimum be complete with interlocks, auxiliary relays, control transformers, and terminals required for proper operation. Refer to the drawings for further details of mechanical equipment control and wiring requirements.

.9 Splitter trough, junction, pull and outlet boxes

.1 Splitter Trough: Supply Type 1 steel splitter trough in accordance with CSA C22.2 No. 76 where indicated on drawing plans, schedules, and details. Enclosures are to be NEMA/EEMAC Type 2 in sprinklered areas and Type 1 elsewhere.

.2 Pull Boxes and Junction Boxes: Supply CSA certified accessible pull box in conduit systems wherever shown on the drawings, and/or wherever necessary to facilitate conductor installations. Supply CSA certified accessible junction boxes wherever required and/or indicated on the drawings. Boxes in rigid conduit and EMT inside the building are to be stamped galvanized or prime coated steel. Boxes in exterior rigid conduit are to be “Condulet” cast aluminium gasketed boxes, and boxes in PVC conduit are to be rigid PVC boxes.

.3 Outlet Boxes: Supply an outlet box for each luminaire, wiring device, fire alarm system component, communications systems components, and all other such outlets. Outlet boxes flush mounted in interior construction, surface mounted in concealed interior locations, and surface mounted in exposed interior locations where the connecting conduit is EMT are to be stamped galvanized steel outlet boxes. Outlet boxes for surface mounted for exterior lighting, receptacles, and other device outlets, boxes flush mounted in exterior building surfaces, and boxes mounted in interior device locations where the connecting conduit is rigid, and for boxes in perimeter walls where insulation and vapour barrier is present, are to be “FS” or “FD” Series cast boxes, cast iron inside the building, cast aluminium outside the building.

.10 Wiring Devices

.1 Supply wiring devices where shown/specified. Wiring devices are to be CSA certified as a minimum, in accordance with CAN/CSA C22.2 No. 42, General Use Receptacle, Attachment Plugs and Similar Wiring Devices, CAN/CSA C22.2 No. 42.1, Cover plates for Flush Mounted Devices, and CSA C22.2 No. 111, General Use Snap Switches. Wherever possible, all wiring devices are to be supplied by the same manufacturer. Acceptable manufacturers are Hubbell Canada, Cooper Industries (Arrow Hart), Legrand/Pass and Seymour, and Leviton Canada.

.2 Supply specification grade white wiring devices as shown on the drawings. Devices are indicated with Hubbell part numbers and noted below:

.1 Heavy Duty Devices

.1 15 A, 120 V Toggle Switch: 1201, 1203

.2 20 A, 347 V Toggle Switch: 18201, 18203

.3 15 A, 120 V Duplex Receptacle 5-15R: 5262

.4 20 A, 120 V Duplex Receptacle 5-20R: 5362

.5 15 A, 120 V GFCI Duplex Receptacle 5-15R: GF5262

.6 20 A, 120 V GFCI Duplex Receptacle 5-20R: GF5362

.7 Weatherproof in-use receptacle cover: WP826

.2 Decorator Style 120 Volt Devices

.1 15 A, 120 V Rocker Switch: DS115, DS315, DS415

.2 20 A, 120 V Rocker Switch: DS120, DS320, DS420

.3 15 A, 120 V Duplex Receptacle 5-15R: DR15

.4 20 A, 120 V, Duplex Receptacle 5-20R: DR20

.5 15 A, 120 V GFCI Duplex Receptacle 5-15R: GF15

.6 20 A, 120 V GFCI Duplex Receptacle 5-20R: GF20

.3 Supply vertically brushed stainless steel coverplates, coloured to match device, for flush mounted devices or galvanized steel type coverplates with rounded corners for surface mounted devices as appropriate for all outlets, ganged type for all grouped outlets. Supply special receptacles and outlet types as identified on the drawings.

.4 Supply time switches for control of mechanical and electrical loads and systems as described below and identified on the drawings.

3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions:

.1 Carefully examine the site and tender documents for the work in accordance with the Instructions to Bidders. Visit the existing building and become familiar with existing architectural and structural conditions, the location of existing electrical equipment and installations and other factors related to the work to be done. Review spaces above accessible ceilings. No extra charges will be considered for anything which could have been revealed during such examinations.

3.2 PREPARATION

.1 Obtain and pay for all permits required for the execution and inspection of the electrical work. All work shall be provided by qualified journeyman electricians or apprentices holding valid Provincial Certificates of Qualification and be supervised by a competent foreman.

.2 Distribution equipment arc flash analysis

.1 Prepare and submit (with shop drawings) to the Consultant an arc flash analysis report containing an introduction, summary of analysis performed, results, calculations, and recommendations in accordance with requirements of NFPA 70C and IEEE 1584, identifying the arc flash hazard boundary, incident energy level, and required personnel protective equipment. Provide arc flash warning labels for equipment included in the report.

.3 Distribution equipment short circuit current coordination study

.1 Prepare and submit (with shop drawings) to the Consultant and to the Electrical Authority for record, a short circuit coordination study and report for the electrical distribution system prepared by a P. Eng. registered in the jurisdiction of the work, employed by the manufacturer of the main switchboard, and using data supplied by the Utility. Use the “Reviewed” study to select the size and interrupting capacity of distribution system protective devices and make field adjustments under the direction of the P. Eng. who prepared the coordination study.

3.3 INSTALLATION

.1 Excavation and backfill work

.1 Do excavation, backfill and related work required for this Division. Grade trench excavations as required. Backfill trenches within the building with clean sharp sand in individual layers of maximum 150 mm (6 in) thickness compacted to a density of 100% Standard Proctor. Hand compact the first layers up to a compacted level of minimum 300 mm (12 in) above the top of the service. Hand or machine compact the balance up to grade.

.2 Backfill trenches outside the building (not under roads, parking lots or traffic areas), up to a compacted level of 450 mm (18 in) thick above the service, hand compacted to a density of 95% Standard Proctor using granular "A" gravel. Backfill the balance in 150 mm (6 in) layers with approved excavated material, compacted to 95% Standard Proctor density.

.3 All concrete shall be formed in place, be rated minimum 25 MPa and be provided as a continuous pour. Provide steel reinforcement where indicated. Concrete encased ducts shall be provided with a minimum 75 mm (3 in) concrete envelope. Restore to original condition all surfaces, landscaping, etc. disturbed by excavation work.

.4 Prior to excavation, carefully check inverts and locations of existing services and report any serious discrepancy. Contact Utilities to accurately locate their services.

.2 Cutting, drilling, and patching

.1 In general, all necessary cutting and patching for the electrical work shall be completed by the appropriate trade at the expense of this Division unless indicated otherwise on the drawings. Holes through exterior walls and roof are to be properly flashed and made weatherproof. Repair any damage caused by this Division to existing buildings or equipment, etc., to the Consultant's satisfaction.

.2 Do cutting, drilling and patching of the existing building for the installation of your work. Patch surfaces, where required, to exactly match existing finishes using. Where new conduit and similar products penetrate existing construction, core drill an opening sized to leave 12 mm (½ in) clearance around conduit, etc. In poured concrete construction, determine the location, if any, of existing concealed services. Pack and seal the void between conduit, etc., openings for the length of the opening in interior construction with rock wool and seal both ends of the opening with non-hardening silicone base caulking. Seal sleeves in exterior walls below grade (and any other wall where water leakage may be a problem) with link type mechanical seals.

.3 Install all sleeves, inserts hangers and core drilling of slab required for the electrical work. All sleeves or holes piercing acoustical, weatherproof, or fire separations for installations of this Division shall be treated by the Contractor to maintain the applicable rating or seal.

.4 Install all sleeves, inserts, hangers and core drilling of slab required for work of this Division. Treat all sleeves or holes piercing acoustical separations for installations of this Division to maintain acoustical rating. All gaps shall be packed with acoustical insulation and sealed at both ends with acoustical caulking. Patch all openings around installations of this Division piercing fire or smoke separations with an approved watertight smoke and fire stop sealant such as manufactured by Dow Corning.

.5 Where conduit/conductors penetrate new concrete and masonry surfaces install proper sleeves. Sleeves in waterproofed slabs or walls are to be complete with a water stop. Size sleeves to leave 12 mm (1/2 in) clearance around the conduit/conductor. Pack and seal the void between sleeves and the conduit in interior non-fire rated construction for the length of the sleeves with mineral wool and seal both ends of the sleeve with silicone base caulking. Pack seals in fire rated construction as above but use rock wool and leave space at sleeve ends for fireproofing. Seal sleeves in exterior walls below grade (and any other wall where water leakage may be a problem) with mechanical seals equal to Thunderline (Power Plant Supply) "LINK SEAL" Model S-316.

.6 Where electrical work penetrates fire rated construction, use ULC listed and labelled firestopping and smoke seal materials installed in accordance with requirements of CAN4-S115 (ratings F, FT, FH, and FTH as required), CAN/ULC-S101, and other governing authorities.

.7 Terminate sleeves for exposed so that the sleeve is flush at both ends with the building surface concerned and install chrome plated brass or brushed stainless steel escutcheon plates tight against the building surface to completely cover both ends of the sleeve.

.8 Scan or x-ray floor slab or structural walls and submit results to the consultant for review and approval, complete with proposed locations of new penetrations, prior to drilling. Core drilling shall be carried out after normal working hours at a time acceptable to the Owner. All costs associated with this work shall be included in the bid price.

.3 Fastening and securing hardware

.1 Install fastening and securing hardware to maintain installations attached to the structure or to finished floors, walls and ceilings in a secure and rigid manner capable of withstanding the dead loads, live loads, superimposed dead loads, and any vibration of the installed products. Where construction is not suitable to support the loads, install additional framing or special fasteners to ensure proper securement to the structure. Do not attach fasteners to steel deck without written consent from the Consultant.

.4 Conduit and Conductors

.1 Ensure all outlet boxes which pierce a building vapour barrier are installed with vapour barrier protection integral with specific wall or ceiling construction. Verify exact requirements on site with the Consultant prior to proceeding with installations.

.2 In areas with solid ceilings, electrical and systems junction boxes along with associated wire and conduit shall be relocated to areas where ceiling access is possible, or access panels. Install prime coated steel access panels for electrical work which may need maintenance or repair, but which is concealed in inaccessible construction. Install access doors in fire rated construction are to be ULC listed and labelled and of a rating to maintain the fire separation integrity. Recessed door type access panels located in surfaces where special finishes are required are to be constructed of stainless steel with a #4 finish.

.3 Unless otherwise specified, locate and arrange horizontal conduits, raceways, and conductors above or at the ceiling on floors on which they are shown, arranged so that under consideration of all other work in the area, the maximum ceiling height and/or usable space is maintained. Install all exposed conduits, raceways, and conductors parallel to building lines and to each other. Conduit, raceway, conductors, etc., must be supported from the structure.

.4 Install proper adaptors for joining conduit of different materials.

.5 In all cases, use only conduit and raceways approved for the particular application and of adequate size to suit type and number of conductors being carried. Install a separate ground conductor in all conduits. Where indicated, use conduit as specified. Adequately secured every conduit or section of armoured cable using approved supports, clamps and fasteners to ensure a safe and sound installation. Conceal in walls, ceilings or furring all conduit or armoured cable run in finished areas, unless otherwise indicated or approved by the Consultant. Do not use armoured cable where exposed unless otherwise noted.

.6 Pigtail connect neutral conductors at all devices. Join all conductors using approved solderless wing nut pressure connectors. All wiring shall be installed according to manufacturer's recommendations, all regulatory requirements and shall satisfy all applicable codes. Check and replace, as required, any existing wiring being re-used.

.7 Feeders and branch circuits rated 100 A or greater shall be checked with a 1000 V meggar for 15 s before energization.

.5 Power and control wiring for mechanical work

.1 Do all required line voltage wiring for mechanical work. Install receptacles for plug-in equipment. Install disconnect switches for motors that are more than 10 m (30 ft) from the starter location, or that cannot be seen from the starter location and associated power wiring. Install motor starter interlocking more than 24 volts. Install dedicated 120 V, 15 A, single pole identified circuits terminated in junction boxes in mechanical equipment rooms for automatic control wiring connections to be made as part of the mechanical work.

.6 Wiring Devices

.1 Confirm exact locations, including mounting heights prior to roughing-in. For accessible mounting heights for devices, conform to Building Code requirements. Confirm switch, receptacle and faceplate types, colours and finishes prior to ordering. Ensure that switches located adjacent to doors are located at the strike side of the door. Install fire rated gaskets in outlet boxes for switches and receptacles located in fire rated construction. When installation is complete, test operation of devices.

.2 Unless otherwise indicated or at the same location as another control device, mount light switches and control devices at 1100 mm (43 in) to the centre of the outlet box. Mount wall outlets and receptacles at 460 mm (18 in) or 150 mm (6 in) above countertop or back splash as applicable to centre of outlet box. Mount thermostat or a manual pull station at 1200 mm (47 in) above finished floor to centre of outlet box.

.3 All switches and outlet location shall be coordinated with furring, pipe chases, etc. prior to rough-in to ensure adequate space is available for device mounting.

.7 Electric Heaters

.1 Install all heaters and associated equipment in accordance with the manufacturer's instructions.

.8 Distribution Equipment and Control

.1 Install legible signs and barriers on or around all live panels and equipment during construction to prevent injury or shock.

.2 Install panelboards as scheduled where shown. Wall mount panelboards independent of connected conduit. Accurately install with reference to wall finish and confirm exact locations prior to roughing-in.

.3 Include panel or breaker schedules to reflect changes and additions. Install labels for all new equipment.

.4 Install suitable wall mounting platform or 100 mm (4 in) concrete housekeeping pad as applicable and external neoprene vibration isolators for all transformers and floor mounted distribution equipment.

.5 Install sprinkler-proof hoods and doors for electrical equipment installed in sprinklered areas.

.9 Splitter trough, junction, and pull and outlet boxes

.1 Rigidly secure the splitter trough in place, level and plumb. Ensure that the splitter trough itself, and all branch circuits, are properly identified.

.2 Install blank covers as required or shown for all wiring systems. Install all boxes to be accessible, if necessary, supply access panels. Secure all boxes independent of the conduit/wiring system. Accurately locate and identify concealed pull boxes and junction boxes on “as-built” record drawings.

.10 Grounding and Bonding

.1 Complete all grounding required by the Electrical Code or any local authorities regardless of whether it has been shown. This includes equipment grounding as well as system (service) and distribution grounding. Install additional specific provisions as indicated, including ground connections for main electrical room and building structure. Provide these installations according to Electrical Code regulations. Collect all ground connections at a common point in the main electrical room, which in turn is connected to the main service ground.

.2 All grounded feeders and branch circuits shall be provided with a separate ground conductor sized according to the Electrical Code regulations. The conduit system shall not be used as the ground path, however all conduits shall be solidly grounded.

.3 Arrange grounds such that under normal operating conditions current flow in any grounding conductor is not objectionable and will not harm personnel or equipment. Arrange service grounds and distribution grounds to provide ground resistance readings within values required by the Electrical Code and the Electrical Authority.

.4 For telecommunications grounding and bonding install ground bus, cabling and complete all bonding terminations in compliance with latest edition of ANSI/TIA 607.

.11 Identification

.1 Install identification nameplates for all electrical apparatus. All identification nameplates and nametags unless otherwise specified shall be engraved white letters on black Lamicoid stock with bevelled edges. The Lamicoid stock shall be 1.5 mm (1/16 in) minimum thickness. Identification tag is to follow drawing nomenclature unless otherwise specified. Label all junction boxes with black ink marker identifying circuits, source panel, and systems.

.2 Equipment Nameplates: Install Lamacoid identification nameplates for equipment and shall include equipment tag, voltage(s), phase, and electrical source. Secure nameplates to equipment with stainless steel screws unless such a practice is prohibitive, in which case use epoxy cement applied to cleaned surfaces. For multi-cell or multiple component equipment provide a main nameplate and a smaller nameplate for each cell or component.

.3 Terminal Cabinets, Pull Boxes, Junction Boxes: Clearly identify terminal cabinets, main pull and junction boxes by neatly spray painting the outside surface of the cover with a paint colour as specified for conduit and conductor identification. Supply a nameplate on terminal boxes, main pull and junction boxes. Nameplates must indicate the load source circuit, voltage, and phase.

.4 Panelboards: Nameplates must identify the panel tag, voltage, phase, and electrical source. Include a machine-printed door directory card indicating the load connected to each breaker.

.5 Wire and Cable Terminations: Identify both end of wire and cable terminations with the same unique number with appropriate self-adhesive labels. Where numbers or tags are not indicated or specified, assign a number and record them.

.6 Distribution System Schematic Diagrams: Prepare AutoCAD, coloured, 1200 mm x 900 mm (48 in x 36 in) single line diagrams of electrical distribution systems to identify equipment and circuits. Install framed and UV-protected glazed diagrams in electrical rooms housing the system equipment. Confirm location prior to installation. Include reduced size copies of the diagrams in each copy of the O & M Manuals.

3.4 REPAIR / RESTORATION

.1 Renovation Work

.1 Visit the site to determine the extent of demolition, removal, relocation, re-routing and reconnection of existing electrical equipment, fixtures, outlets and wiring required for the execution and completion of this project. In general, relocate existing services as required to accommodate new equipment and installations and architectural changes. In areas being totally renovated, provide all electrical demolition work and replace existing installations with new as shown. Extra charges for premium time labour, if required to complete the project as described, shall be included in the bid price.

.2 Where indicated on the drawings, disconnect and remove electrical work, including conduit, conductors, and similar items. Cut back obsolete conduit behind finishes, identify, and cap water-tight. Estimate the extent and cost of the work at the site during bidding period scheduled site visit(s). Perform demolition work in accordance with requirements of CAN/CSA-S350, Code of Practice for Safety in Demolition of Structures.

.3 Unless otherwise specified, remove and dispose of demolished materials which are not to be relocated or reused.

.4 Clean all existing products to be reinstalled.

.5 Sequence of disconnection and removal and/or relocation of existing equipment and wiring shall be co-ordinated with the Owner and other trades and shall conform to the requirements and conditions of the Project Manager.

.6 Wiring located in areas being altered but feeding outlets or equipment in other areas required to remain in service, shall be reworked, extended and re-routed as required to maintain the continuity of these services. Provide adequate protection to existing wiring and equipment which has become exposed to mechanical injury in the course of alterations or new installations.

.7 Install all conduit and feeders running through the existing building along routes approved on site by the Owner and Consultant. New installations will not necessarily be allowed along shortest routes but should follow corridors or routes of existing main runs where possible.

.8 Modify/upgrade existing installations affected by work of this project in accordance with the Electrical Authority requirements. New devices installed in existing equipment shall match type and quality of existing devices and be fully compatible with and be approved for use in the existing equipment. Provide all appropriate modifications to existing panels to allow installation of additional distribution breakers or fusible switch units in a manner acceptable to the Electrical Authority.

.9 Update existing panel or breaker schedules to reflect changes and additions. Label all breakers no longer in use as spare and place breaker in off position.

.10 In some instances, new outlets and equipment are shown in the same location as the existing outlets. These may be fed through the existing conduits provided that the conduits are in good condition and are acceptable to the Electrical Safety Authority for re-use. All wiring to new outlets and equipment shall be new unless otherwise indicated. All unused conduit entrance openings shall be sealed.

.11 Unless noted otherwise, all existing electrical equipment which is not to be re-used shall become the property of this Division (for disposal or removal from the site as applicable) and have an appropriate salvage value included in the contract. Existing electrical equipment to be re-used (relocated and reconnected) shall be cleaned, painted, refurbished and repaired as required before reinstallation. (Turn over existing light fixtures and electrical panels not to be re-used to the Owner.)

.12 In finished areas of the existing building, as much wiring as possible shall be concealed. Where, in this Division's opinion it is necessary or advantageous to run wiring on the surface, (not simply to avoid cutting wall or floor) obtain approval from the Consultant before proceeding. All surface raceways installed shall be as manufactured by Wiremold unless otherwise indicated. Wiremold raceways shall be sized as indicated or to suit conductors being carried. Use only approved components, fittings and methods for securing, joining and supporting surface raceways and outlet boxes. Surface mount raceways shall be painted to match the adjacent wall or ceiling finish by a painting contractor at the expense of this Division.

3.5 SITE QUALITY CONTROL

.1 General Electrical Work Testing:

.1 Satisfactorily perform testing required by governing authorities, Codes and Regulations to suit phasing of the work. Test to ensure that there are no leaks, grounds, or crosses, test and establish proper motor rotation, measure full load running currents, and check overload elements. Existing motors that have been disconnected and reconnected must be checked with rotation meter and be responsible for any damage caused by reverse rotation. Demonstrate to the Consultant that branch circuit voltage drop is within specified limits.

.2 Grounding and Bonding System Testing:

.1 Provide visual and mechanical inspection of the grounding and bonding system and verify that the system follows Electrical Code requirements.

.3 Branch Circuit Balancing:

.1 Connect branch circuits to panelboards to balance the actual loads (wattage) to within 5%. If required, transpose branch circuits to achieve this requirement. After the building is occupied and if requested by the Consultant, demonstrate that branch circuit balancing has been achieved.

.4 Health Care Facility Work and Testing:

.1 Install conduit, conductors, and similar work in health care facility patient care areas in accordance with the Electrical Code, including amendments, and utilizing a specialist testing company, inspect and test electrical work in patient care areas in accordance with requirements of CAN/CSA Z32, Electrical Safety and Essential Electrical Systems in Health Care Facilities, and any other governing Codes and Regulations. Invite the Owner and Consultant to witness testing. Prepare, sign and submit test reports.

.5 Site Tests and Inspections:

.1 Test all equipment and wiring at any time requested by the Consultant as part of the Contract. Provide all meters, materials and labour required to carry out this work. Prior to connection of additional loads to existing sources, ensure through load measurement and monitoring that the required excess capacity is available.

.2 Upon completion of the electrical installations, trial operate all equipment, systems and devices to ensure correct functioning. Following satisfactory trial operation, instruct the Owner's representative regarding operation and maintenance of the systems and equipment installed.

.6 Integrated Systems Testing:

.1 Complete integrated testing compliant with CAN/ULC-S1001 for all applicable systems. A qualified Integrated Testing Coordinator shall complete an Integrated Testing Report sealed by the Integrated Testing Coordinator to show compliance with CAN/ULC-S1001 Standard for Integrated Systems Testing.

.2 The Integrated Testing Coordinator is the person, firm, corporation, or organization responsible for the development and implementation of the integrated testing plan. Where a firm, corporation, or organization is responsible for integrated fire protection and life safety systems testing, a representative of that firm, corporation, or organization shall be designated as the integrated testing coordinator. Qualifications required for this position is a professional engineer licensed in the site jurisdiction.

.7 Third-party Agencies:

.1 Technician performing Fire Alarm testing and verification to have a minimum of 5 years' continuous Canadian experience successfully testing projects similar in size and complexity as the Work of this Section. Technician to be a registered CFAA Fire Alarm Technician. Submit proof of experience and credentials upon Consultant's request.

.2 Fire Alarm Verification must be carried out by an agency (or individual) acceptable to the Authority Having Jurisdiction, who can demonstrate they have the sufficient training or experience, and who is not the installing contractor, supplier/integrator, fire alarm manufacturer, or involved in the design or installation of the fire alarm system.

.3 Employ fully trained mechanics who are regularly employed in the field of graphics design and/or sign production to create the fire alarm zoning graphic. Arrange for production of all graphic material. Fabrication of the graphic display shall be by an approved signage supplier or the fire alarm supplier.

3.6 CLEANING

.1 Upon completion of the work, clean all equipment and remove from the site all electrical debris. Where work is being performed in occupied spaces, make safe, replace all removable ceiling tiles, clean all equipment and remove from the site all electrical debris at the end of each shift.

.2 Separate and recycle waste materials in accordance with requirements of Canadian Construction Association Standard Document CCA 81, A Best Practices Guide to Solid Waste Reduction. Do not let waste materials accumulate at the site.

END OF SECTION