

MECHANICAL SPECIFICATIONS
FOR
FORESTSIDE ESTATES
ATTMAR & PALLESCHI DRIVE
BRAMPTON, ONTARIO

ENGINEER'S REFERENCE NO. 18-017

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UNITED ENGINEERING INC

Mechanical and Electrical Consulting Engineers

3645 3645 Keele St. UNIT #105
Toronto, Ontario, M3J 1M6
Email: info@u-eng.ca
Tel: (416) 398-1999; Fax: (416) 398-1933

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1 GENERAL

1.01 SCOPE OF WORK

- .1 It is the intent of these specifications to furnish and install all materials and equipment as hereinafter specified and/or as shown on the drawings in such a manner as to leave each of the systems of the mechanical trades complete and in perfect operating condition.
- .2 The specifications are to be considered as an integral part of the plans which accompany them, neither the plans nor the specifications shall be used alone. Any item or subject omitted from one, but which is mentioned or reasonably implied in the other, shall be considered as properly and sufficiently specified, and must, therefore, be provided. Misinterpretation of either the plans or the specifications shall not relieve this Contractor of responsibility.
- .3 Conform to the applicable provisions of the General Conditions of the Contract.
- .4 This Section specifies 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.
- .5 The subsections of this specification do not relieve the prime Mechanical Contractor of any responsibility of work performed by his subcontractors. The prime Mechanical Contractor shall co-ordinate the mechanical work with his subtrades as well as the other trades performing work in the building, and he shall assume all responsibility for work and equipment installed by his subtrades.
- .6 The work described in these specifications and detailed on the drawings shall be installed in strict adherence to all national codes and standards, local codes and standards, local by-laws and all other authorities having jurisdiction, in the area where the building is to be erected.

1.02 QUALITY ASSURANCE

- .1 All mechanical work is to be done by journeyman tradesmen who perform only the work that their certificates permit, or by apprentice tradesmen under direct on site supervision of an experienced journeyman tradesman. The use of apprentice tradesmen is to be limited and the journeyman/apprentice ratio is subject to the Consultant's approval.
- .2 All journeyman tradesmen are to have valid trade certificates available at the site for review by the Consultant at any time.
- .3 An experienced and qualified superintendent is to be on-site at all times when mechanical work is being performed.

1.03 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 of bidding on this Project.
- .2 All work is to be in accordance with requirements with Codes, Regulations, and Standards applied by governing authorities.
- .3 Where any governing Code, Regulation, or Standard requires preparation and submission of special details or drawings for review they are to be prepared and submitted. Pay all

associated costs associated with these submittals.

- .4 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, ETL, etc., or bear a stamp to indicate special electrical utility approval.
- .5 Requirements of the Contract Documents are to take precedence when they are more stringent than codes, ordinances, standards, and statutes.

1.04 EXAMINATION OF SITE AND DOCUMENTS

- .1 Each subcontractor, before tendering shall examine the site, the Architectural, Structural, Mechanical and Electrical drawings, and he shall familiarize himself with the building construction and finish in order that his tender may include everything necessary for the proper completion of the work.
- .2 Report to the Consultant, prior to bid submittal, any existing site condition that will or may affect performance of the work as per the drawings and specifications. Failure to do so will not be grounds for additional costs.
- .3 It shall be this Subcontractor's responsibility that material and equipment brought into the building shall be of such assemblies and sizes as to enter into the spaces where they are to be located into the building without difficulty. Any cutting, patching, etc., involved in getting large assemblies into place shall be the responsibility of this Subcontractor.

1.05 ACCEPTANCE

- .1 The submission of a bid proposal will be considered as evidence that the Contractor has visited the site, familiarized himself with the drawings and the contents of this specification and accepts the terms and requirements herein.

1.06 RELATIONSHIP OF OTHER TRADES

- .1 This Subcontractor shall confer with all other contractors installing equipment, plant piping, other work, foundations etc., which may affect his installation, and he shall arrange his equipment, piping, etc., in proper relation with other apparatus, plant and with the building construction. He shall also confirm the electrical characteristics of the project and order equipment accordingly.
- .2 Special care shall be taken in the installation of all work, to see that they all come within the limits established by the finish lines of all walls, floors, ceilings etc.
- .3 The Subcontractor shall notify the Contractor and other Subcontractors who are concerned, of all openings, foundation work, hangers, inserts, anchors, or other provisions necessary in their work for the installation of his work, and he shall furnish all information and necessary materials in ample time so that proper provisions can be made for same, and shall supply and correctly and accurately place all inserts, sleeves, anchors, etc.
- .4 Failure to comply with these requirements on the part of this Subcontractor will render him responsible for the cost of cutting openings, installing hangers and other provisions at a later date, and the subsequent patching, etc., thereby required.

No cutting shall be done without permission. All such work shall be done by certified tradesmen skilled in this particular trade.

1.07 REQUIREMENTS OF INSPECTION DEPARTMENTS

- .1 All work shall be installed in accordance with all laws and regulations of all authorities having jurisdiction in each case, particularly all affected departments of the Municipality and Province. Electrical equipment supplied must conform to the regulations of CSA and the local utility. Anything necessary to make the work comply with these requirements shall be provided by this Subcontractor without additional cost to the Owners if the item could have been foreseen when tendering.
- .2 Each subcontractor shall prepare drawings in addition to Engineer's drawings as may be required by various Inspection Departments having jurisdiction with the work.
- .3 All minor changes and/or alterations required by an authorized inspector of any authority having jurisdiction, shall be carried out without additional charge or expense to the Owner. In the event that the authorized inspector imposes a major deviation to the design or layout shown on the engineering drawings, the Contractor shall consult with the Engineer prior to proceeding with the work.

1.08 PERMITS, FEES, AND CERTIFICATES

- .1 Subcontractor shall give all necessary notices and obtain all required permits. Pay all fees except for street connections to storm and sanitary sewers and for water connections which will be made by others, in order that the work herein specified may be carried out. Arrange with the local municipality exact day of installation and obtain exact inverts of said services and furnish any certificates needed as evidence that the work installed conforms with the laws and regulations of the Municipality and Province, with the requirements of the Canadian Electrical Code, as approved by the local utility, with the Insurance Underwriting Body, the Fire Department.
- .2 Immediately upon award of contract, verify the location and inverts of existing and new underground services affecting this project. Submit a report of any serious discrepancy before proceeding with installation of services. Engage the services of local P.U.C., hydro, telephone and authorities to accurately determine the location of underground services. Avoid disturbing or damaging any existing underground services which may be uncovered while carrying out this work. Be responsible for and make good any such damage, without change to the Contract price.
- .3 All services shall be installed in strict accordance with the requirements of authorities having jurisdiction.
- .4 Submit to the Consultant, all approval/inspection certificates issued by governing authorities to confirm that the work as installed is in accordance with the rules and regulations of the governing authorities. Pay any costs associated with issue of the certificates.

1.09 STANDARD OF MATERIALS AND EQUIPMENT

- .1 Materials and equipment are specifically described and named in this specification for the purpose of establishing a standard of materials and workmanship. In some cases alternate materials, apparatus or equipment is substituted for that which is specified and it is assumed that the quality and/or performance is equal or better than the materials, apparatus or equipment specified. Approval of alternate equipment shall be at the sole discretion of the Engineer, or the Owner.
- .2 All Tender Prices shall be based on the "specified" equipment (not the substitute). In no

instance will items other than which is specified be considered unless the substitutions are named and price adjustments be shown accordingly. The Owners and Engineer shall have final option of accepting or rejecting any alternate equipment, without question.

- .3 If the Owner or Design Build Contractor elects to veto the Engineer's recommendation or approval for acceptance of alternate equipment or materials, then the Owner or Design Build Contractor shall accept full responsibility for the quality, operation and performance of the equipment he has approved.
- .4 All new building construction must conform to the A.S.H.R.A.E. 90.1 standard for energy efficiency. Therefore, all materials and equipment provided for the execution of the work must conform to the minimum energy efficiency ratings listed in the standard.
- .5 All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
- .6 All castings used for coupling housings, fittings, and valve bodies shall be date stamped for quality assurance and traceability.

If the Bidder of this Division states the use of substitute equipment, he shall have made allowance in his savings for any structural or electrical changes necessary, and said changes shall be at the expense of this Division.

1.10 SUBSTITUTED OR ALTERNATIVE PRODUCTS

- .1 Products supplied by a manufacturer/supplier other than a manufacturer listed as acceptable on drawings or specifications, List of Acceptable Manufacturers and Suppliers, may be considered for acceptance by the Consultant if requested in writing a minimum of five full working days prior to the bid closing date. Requests may be made by letter, by fax, or by email. Telephone requests will not be considered.
- .2 Each request for acceptance of a proposed substitution or alternative product must be accompanied by detailed catalogue and engineering data, fabrication information, and performance characteristics to permit the Consultant to make an informed decision.
- .3 Pay for any additional costs and changes to associated or adjacent work resulting from the use of products supplied by a substituted or alternative manufacturer. In addition, in equipment spaces where substituted or alternative products are used in lieu of the specified products or listed on Appendix A and the dimensions of such products differ from the specified or acceptable 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.
- .4 The Consultant's decision regarding any proposed substitution or alternative product is final.

1.11 GUARANTEE

- .1 This Subcontractor shall guarantee all material and workmanship used in the work to be in strict accordance with the specifications, of best quality and type obtainable to give first-class construction and proper and efficient operation, and free from any defects.
- .2 Any such defects which may appear in any of the work within two years after written acceptance of his work shall be repaired and replaced by this Subcontractor without

additional expense to the owner. Where such defects occur, this Subcontractor shall be held responsible for all costs incurred in making the defective work good.

- .3 Furnish a letter of guarantee through the General Contractor, covering all systems for one full year from the date of acceptance by the Engineer and or Owner.
- .4 This shall not supersede or nullify any longer warranties or specified items of equipment.
- .5 All injuries to adjacent work, particularly plaster, wood finishes or other materials, or damage to other equipment, caused by such defects of this Subcontractor's work or by subsequent replacement and repairs, shall be made good at the expense of this Subcontractor. All repair work shall be done by trades responsible for the original work.

1.12 DRAWINGS AND SPECIFICATION

- .1 Read the mechanical work drawings in conjunction with all other structural, architectural, sprinkler, electrical, etc., drawings and, where applicable, the Code Consultant's report, Acoustic report.
- .2 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. Do not scale the drawings, and do not use the drawings for prefabrication work.
- .3 The 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.
- .4 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.
- .5 Sections of the mechanical specification are not intended to delegate functions nor to delegate work and supply of materials to any specific trade, but rather to generally designate a basic unit of work, and the Sections are to be read as a whole.
- .6 The mechanical specification does not generally indicate the specific number of items or extent of material required. The specification is intended to provide product data and installation requirements. It is necessary to refer to drawing schedules, layouts, schematic diagrams, riser diagrams, and details to determine correct quantities.
- .7 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.
- .8 The mechanical drawings and specifications have been prepared solely for the use by the party with whom the Consultant has entered into a contract and there are no representations of any kind made by the Consultant to any other party.
- .9 When the scale and date of the drawings are the same, or when the discrepancy exists within the specification, the most costly arrangement will take precedence.
- .10 In the case of discrepancies or conflicts between the drawings and specification, the documents will govern in the following order:

- .1 the specification;
- .2 drawings of later date.
- .11 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 most costly arrangement will take precedence.
- .12 Items obviously required to provide a complete working system, but not specified nor shown shall be included.

1.13 PLANNING AND LAYOUT OF THE WORK, AND ASSOCIATED DRAWINGS

- .1 Properly plan, coordinate, and establish the locations and routing of services with all subcontractors affected prior to installation such that the services will clear each other as well as any obstructions, including structural components of the building.
- .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 Revise or alter the arrangement of work that has been installed without proper coordination, study and review, even if it was completed in accordance with the Contract Documents, in order to conceal the work behind finishes, or to allow the installation of other work, at no additional cost. In addition, pay for the cost of alterations in other work required by the alterations to your work.
- .4 All shut-off valves, balancing devices, air vents, equipment and similar products, particularly such products located above suspended ceilings must be located for easy access for servicing and/or removal. Products which do not meet this location requirement are to be relocated to an accessible location at no additional cost.
- .5 **Layout Drawings:** Do not use the Contract Drawing measurements for prefabrication and layout of piping and sheet metal work. Locations and routing are to generally be in accordance with the Contract Drawings, however, layout drawings are to be prepared for all such work. Use established bench marks for both horizontal and vertical measurements. 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 Drawings, notify the Consultant prior to proceeding with the work.

1.14 GENERAL RE: INSTALLATION OF EQUIPMENT

- .1 Unless otherwise specified all equipment is to be installed in accordance with the equipment manufacturer's recommendations and instructions, and requirements of governing Codes, Standards, and Regulations. Governing Codes, Standards, and Regulations take precedence over manufacturer's instructions.
- .2 Ensure that proper access and service clearances are maintained around equipment, and, where applicable, access space for future equipment removal or replacement is not impeded. Remove and replace any equipment which does not meet this requirement.

1.15 ENERGY EFFICIENCY STANDARDS

- .1 All applicable mechanical equipment has been selected to meet energy efficiency requirements of ANSI/ASHRAE/IESNA 90.1, Energy Standards for Buildings, and shop drawings/product data submittals for such equipment must indicate compliance with this Standard or they will be returned for correction and re-submittal.

1.16 SHOP DRAWINGS AND PRODUCT DATA SHEETS

- .1 Prior to supplying any products to the site, 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. Shop drawings and product data sheets must indicate that the product for which the shop drawings or product data sheets are submitted meet all requirements of the Contract Documents. The number of copies of shop drawings and/or product data sheets will be as later directed.
- .2 Each shop drawing or product data sheet is to be properly identified with the project name and the product drawing or specification reference, i.e. "Exhaust Fan EF-1", and all shop drawing or product data sheet dimensions are to be either SI or Imperial to match dimensions on the drawings.
- .3 Where any item of equipment is required by Code or Standard or By-Law to meet a specific energy efficiency level, or any other specific requirement, ensure that this requirement is clearly indicated on the submission.
- .4 Carefully review each shop drawing and product data sheet prior to submittal to ensure that the proposed product is correct and meets with all requirements of the Project. Endorse each copy of each shop drawing or product data sheet "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 as above.
- .5 The Consultant will review shop drawings and product data sheets and will indicate the review status by stamping the shop drawings and product data sheets as follows:
 - .1 **"Reviewed" or "Reviewed As Modified"** to indicate that his review is final and no re-submittal is required;
 - .2 **"Revise and Re-submission"** to indicate that the submission is rejected and is to be revised in accordance with comments marked on the shop drawings and product data sheets by the Consultant and re-submitted.
- .6 The following is to be read in conjunction with the wording on the Consultant's review stamp applied to each and every mechanical work shop drawing or product data sheet submitted:

"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."

.7 Manufacturer

- .1 Provide valves of same manufacturer throughout, where possible.
- .2 Provide valves with manufacturer's name and pressure rating clearly marked on body (per MSS-SP-25).
- .3 Product shall carry valid CRN (Canadian Registration Number) issued by respective Provinces.

1.17 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 Documents, prepare and submit to the Consultant for approval, a quotation being your proposed cost for executing the change or revision.
- .2 Your quotation is to be a detailed and itemized estimate of all product, labour, and equipment costs associated with the change or revision, plus overhead and profit percentages and all applicable taxes and duties.
- .3 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 costs are not to exceed those published in local estimating price guides;
 - .3 mechanical material labour unit costs are to be in accordance with the Mechanical Contractors Association of America Labor Estimating Manual, less 25%;
 - .4 electrical material labour unit costs are to be in accordance with the National Electrical Contractors Association Manual of Labor Units, less 25%;
 - .5 costs for journeyman 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;
 - .6 cost for the site superintendent must not exceed 10% of the total hours of labour estimated for the change or revision, and the change or revision must be such that the site superintendent's involvement is necessary;
 - .7 costs for rental tools and/or equipment are not to exceed local rental costs;
 - .8 if overhead and profit percentages are not specified in the General Conditions of the Contract, Supplementary Conditions, or elsewhere in preceding Sections of the Specification, but allowable under the Contract, then allowable percentages for overhead and profit are to be 20% and 10% respectively;
 - .9 the overhead percentage will be deemed to cover all quotation costs other than actual site labour and materials, and rentals;

- .10 all quotations, including those for deleted work, must include a figure for any required change to the Contract time.
- .4 Quotations submitted that are not in accordance with requirements specified above will be rejected and returned for re-submittal. 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.
- .5 If, in your opinion, changes or revisions to the work should be made, inform the Consultant in writing and, if the Consultant agrees a Notice of Change will be issued.
- .6 Do not execute any change or revision until written authorization for the change or revision has been obtained.

1.18 NOTICE FOR REQUIRED FIELD REVIEWS

- .1 Whenever there is a requirement for the Consultant to perform a field review prior to concealment of any work, to inspect/re-inspect the work for deficiencies prior to Substantial Performance, for commissioning demonstrations, and any other such field review, give the Consultant adequate notice in writing.
- .2 If the Consultant is unable to attend a field review when requested, arrange an alternative date and time.
- .3 Do not conceal work until the Consultant advises that it may be concealed.

1.19 RESPONSIBILITY AND LIABILITY

- .1 Each Subcontractor shall supervise the laying out of his work and shall arrange it in cooperation with others who may be working on the premises while the work of this Contract is in progress.
- .2 If alterations of any kind become necessary due to site conditions, the substitution of equipment or prescribed methods, the mechanical contractor shall assume the costs of these alterations. Equipment substituted shall be approved by the Engineer and shall not exceed the space or power requirements of the previously specified equipment.
- .3 Each Subcontractor shall notify the Engineer in writing of any discrepancies or inconsistencies found in the drawings or specifications before submitting his tender. He shall abide by the decision given him in writing with regard to same. Each Subcontractor is cautioned that the work as shown is intended to be complete in all respects and that failure on his part to notify the Engineer of any discrepancies will not relieve him of the responsibility of completing the work as intended at the contract price.
- .4 On completion of the work all tools, surplus and waste materials shall be removed from the site at this Contractor's expense and the mechanical work shall be left clean and in perfect working condition.

1.20 INSTALLATION OF WORK

- .1 The Mechanical Contractor shall provide and install a complete and fully operational mechanical system conforming to the design intent indicated on the drawings and specifications, with services and facilities to meet the owner's or end user's requirements.
- .2 The Contractor shall promptly install any work or sleeves, in advance of any concrete

pouring work.

- .3 Proceed with the work as quickly as practical, so that the overall construction, may be completed in as short a time possible, and in accordance with the building schedule.
- .4 The Mechanical Contractor is to ensure that all equipment and material is ordered in time to meet the overall construction schedule.

1.21 WORKMANSHIP

- .1 Only first class workmanship will be accepted, not only with regard to safety, efficiency, durability, etc., but also with regard to neatness and cleanliness of appearance, for piping, ductwork and equipment. Obtain general arrangements from drawings and dimensions of finished work on premises or from dimensioned drawings showing actual location of pipes, ductwork, etc. Drawings shall not be scaled for location of pipes, ducts, or equipment in areas where allocation of spacing is critical.
- .2 Grooved joint shall be installed in accordance with the manufacturer's written recommendations. Grooved ends shall be clean and free from indentations, projections, or roll marks. The gasket shall be molded and produced by the coupling manufacturer of an elastomer suitable for the intended service. The coupling manufacturer's factory trained representative shall provide on-site training for the contractor's field personnel in the use of grooving tools and installation of product. The representative shall periodically visit the job site to ensure best practices in grooved product installation are being followed. (A distributor's representative is not considered qualified to conduct the training.)
- .3 Equipment shall be accurately set, plumbed and levelled and hanger rods shall be similarly set in true vertical alignment.

1.22 RECEIPT AND INSTALLATION OF PRE-PURCHASED EQUIPMENT

- .1 The building owner may elect to pre-purchase equipment directly from the manufacturer and turn over the pre-purchased equipment to this Contractor for installation as part of the performance of the work. Pre-purchased equipment shall be identified on the drawings, specifications and in the Mechanical Tender Forms.
- .2 This Contractor shall provide rough-in for pre-purchased equipment which are within the scope to install and all other components essential for the equipment's proper operation. This Contractor to obtain a copy of the approved shop drawings for all pre-purchased equipment within his scope to install, from the owner, prior to any installation of services or rough-in for the equipment.
- .3 Site Superintendent and this Contractor shall count and inspect all items and accessories which are pre-purchased by the owner, but are within his scope of work to install, immediately when these items are shipped to the site. Site Superintendent and this Contractor shall confirm that all pre-purchased items have been shipped and are complete and undamaged.
- .4 Site Superintendent and the Contractor shall notify the owner, in writing, of any damaged or short shipped items immediately following the count and inspection and shall provide a copy of the shipping company's itemized bill of lading. Any equipment damaged or missing on delivery to site and not reported by this Contractor, shall be assumed missing or damaged while in this Contractor's care.

- .5 This Contractor shall protect pre-purchased equipment from damage, theft or the elements as required.
- .6 The Project Superintendent shall give this Contractor advanced notification of pre-purchased equipment deliveries to site. This Contractor and the Site Superintendent shall arrange for a secure storage area for the pre-purchased equipment prior to equipment delivery.
- .7 This Contractor shall take possession of all pre-purchased equipment within his scope to install, upon delivery to the site and shall lift, uncrate and install the equipment as shown on the drawings. Remove all shipping cartons and crates from the site.
- .8 This Contractor shall assume full responsibility for the pre-purchased equipment, under his care. The Contractor shall bear the costs incurred for the repair or replacement of damaged or stolen equipment while under his care..
- .9 All pre-purchased equipment shall be installed and commissioned per the manufacturer's recommendations and warranty provisions. Any improper installation, damage, or any action or inaction resulting in the voidance of the equipment warranty; this Contractor shall assume full responsibility for corrective action and/or assume the duties or costs of that warranty, should the unit require service or repair within the original warranty period.

1.23 HOISTS AND SCAFFOLDS

- .1 Provide hoists, scaffolds, staging, runways, planking and ladders as required during execution of this work.
- .2 Locations for securing chain blocks, hoists and other hoisting equipment to building steel or construction, shall be approved in advance by the Structural Engineer.
- .3 No drilling, cutting or welding of building steel or building construction for installation of materials or equipment shall be allowed without prior approval of the Structural Engineer.

1.24 CUTTING AND PATCHING

- .1 All cutting and patching shall be done by the trades specializing in the materials to be cut or repaired.
- .2 Should any cutting and/or repairing of finished surfaces be required, the Contractor shall employ the particular trades engaged on the site for this type of work to do such cutting and/or repairing. Obtain the approval of the Architect before doing any cutting. In the event that tradesmen required for particular cutting and/or repairing are not already on the site, bring to the site, the required tradesmen to do this work.
- .3 Supporting members of any floor, wall, or the building structure shall be cut only in such a location and manner as approved by the Structural Engineer.

1.25 CLEAN-UP

- .1 During the course of construction, each Subcontractor shall keep his work tidy and not allow an accumulation of debris resulting from his work.
- .2 Upon completion of his work he shall leave the premises in a broom-clean condition.

1.26 PROTECTION

- .1 Protect the work from construction dirt or damage from any cause. Securely plug and cap all openings in pipe, equipment and fixtures to prevent obstructions.
- .2 Protect all indoor equipment control panels from the outdoor elements while on site awaiting installation, or prior to the enclosure of the building area where the equipment is to be installed.

1.27 TRIAL USAGE

- .1 When directed by the Consultant, promptly arrange, pay for, and perform site tests on any piece of equipment or any system for such reasonable lengths of time and at such times as may be required to prove compliance with the Specification and governing Codes and Regulations, prior to Substantial Performance of the work.
- .2 When, in the opinion of the Consultant, tests are required to be performed by a certified testing laboratory, arrange and pay for such tests.
- .3 All tests are not to be construed as evidence of acceptance of the work, and it is agreed and understood that no claim for damage will be made for injury or breakage to any part or parts of the equipment or system due to the test where such injuries or breakage were caused by faulty parts and/or workmanship of any kind.
- .4 When, in the Consultant's opinion, tests indicate that equipment, products, etc., are defective or deficient, immediately remove such equipment and/or products from the site and replace them with acceptable equipment and/or products, at no additional cost.

1.28 ELECTRICAL WIRING, CONTROLS AND WIRING DIAGRAMS

- .1 All power wiring for mechanical equipment shall be done by the Electrical Division. Power wiring is considered wiring to provide primary power to the equipment 120 to 600 volts. The Mechanical Trade shall provide motor starters, relays, and control transformers to the Electrical Division for installation.
- .2 All control and interlock wiring shall be provided by the Mechanical Contractor. Control wiring is considered wiring used to communicate signals from a control or switch to the equipment it serves, and in most cases the voltage is below 120 volts. However; some controls operate at line voltage (120V or more), such as line voltage thermostats, actuators or interlocks between two pieces of equipment. Where control wiring is at line voltage, the Mechanical Contractor shall retain the services of a licensed Electrician to perform the work. The Mechanical Contractor is responsible for all control wiring regardless of voltage, and for the proper operation and control of the equipment and accessories installation of this contract.
- .3 Provide with shop drawings, a comprehensive wiring diagram for all mechanical equipment requiring review.
- .4 The wiring diagram must be specifically made up for this job, showing the terminal points of the mechanical equipment. Co-ordinate the equipment being supplied under this contract where it is directly connected to the part of the mechanical installation.
- .5 The Electrical Contractor shall provide all weather-proof non-fused disconnects for roof mounted equipment supplied by the Mechanical Contractor, except as provided in (.1).
- .6 All starters and controls, including thermostats, in public areas shall come in suitable lockable boxes or shall tamperproof.

1.29 ELECTRICAL APPARATUS

- .1 All electrical features of mechanical items shall be of Canadian manufacture where possible, and in all cases approved by the electrical utility.
- .2 All motors shall be sized as follows unless specified on the drawings:

Below 1/2 H.P.	120/1/60
1/2 H.P. and Over	3/60 and voltage of the project CONFIRM ON SITE
Over 1 H.P.	High efficiency motors must be used where compliance to A.S.H.R.A.E. 90.1 is mandatory.

1.30 TEMPORARY HEAT

- .1 All heating equipment with respect to temporary heat shall be supplied by the General Contractor for the general use of the building trades. Fuel for all heating shall be supplied by the General Contractor. (see 3.)
- .2 The permanent heating equipment will be used only when directed by the Engineer for providing temporary heat. The General Contractor must have qualified personnel on the site to supervise the operation of the equipment to ensure against freeze-up, flooding, etc.
- .3 The Mechanical Division shall be responsible for the provision of temporary gas piping for temporary heating of the project.

1.31 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 from the equipment manufacturer/supplier to the Owner. Submit signed and dated copies of extended warranties which clearly state requirements specified above.

1.32 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.

1.33 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:
 - .1 submit a copy of each equipment/system manufacturer's start-up report sheet to the Consultant for review, and incorporate any comments;
 - .2 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.

1.34 EQUIPMENT AND SYSTEM COMMISSIONING

- .1 After successful start-up and prior to substantial performance, commission the mechanical work. Commissioning work is the process of the contractor 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, as further described below.
 - .1 **Operational Performance Testing:** The Contractor is to test, adjust and operate components, equipment, systems and/or subsystems 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. The Contractor is to complete commissioning data sheets to documents successful operational performance testing.
 - .2 **Functional Performance Testing:** The Contractor is to repeat successful operational performance testing with completed commissioning data sheet documentation by the Contractor in the presence of the Consultant and Owner to validate and verify that the equipment, systems and subsystems are complete in all respects, function correctly, and are ready for acceptance.
 - .3 **Testing, Adjusting, and Balancing:** The Contractor is to retain the services of a testing, adjusting, and balancing agency to perform testing and balancing of mechanical system air/fluid flows and capacities, as per the mechanical work Section entitled Testing, Adjusting and Balancing and prior to operational performance testing.
 - .4 **Submittals:** The Contractor is to submit final commissioning data sheets, TAB reports as specified in the Testing, Adjusting and Balancing Section, project closeout documents, and other required submittals.

1.35 PROJECT CLOSEOUT SUBMITTALS

- .1 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.

.2 Tests and Balancing

- .1 Provide the Engineer with a letter stating that all systems and equipment provided have been checked and adjusted to the manufacturer's recommendations under this supervision.
- .2 Provide a Balancing Report for all ventilation and air handling systems, prepared by an independent Balancing Contractor certified by either the Ontario Environmental Balancing Bureau or the Associated Air Balancing Council. Submit three(3) copies of the Balancing Reports to the Engineer for review.
- .3 Replace or clean filters, replace indicator bulbs, and lubricate all machinery immediately prior to turn-over of the building to the Owner.
- .4 Lubricate all units and clean equipment immediately prior to turnover. Demonstrate proper operating and maintenance procedures to the Owner, and provide two (2) copies of these instructions along with shop drawings and manufacturer's bulletins suitably bound, titled and bearing the name, address and telephone number of the Contractor.
- .5 Test all piping systems for leaks, prior to insulating, and connection of equipment which may not stand the test pressure.
- .6 Maintain test pressure of three times working pressure for a period of six consecutive hours, with not more than a 5% drop.

.3 Operating and Maintenance Manuals:

- .1 Three(3) Operating and Maintenance Manuals shall be provided for all equipment or special apparatus. Shall be provided in three-ring binders, to the owner. The manuals shall contain the following information under the respective headings:
 - .1 General Arrangement Shop Drawings
 - .2 Sequence of Operation and Operating Principles
 - .3 Complete Parts Lists and Numbers
 - .4 Recommended Maintenance and Precautions
 - .5 Complete Wiring and Connection Diagrams
 - .6 The Contractor's Name and Telephone Numbers & Statement of Warranty of two years from Commissioning Date and the Letter of Commissioning.

.4 Record "As-Built" Drawings

- .1 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.

- .2 **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.
- .3 **Obtaining CAD Discs:** 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, discs of the Contract Drawings will be supplied free of charge by the Consultant.
- .4 **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 disc of the as-built drawings, and a bound set of white prints (of equal quality to the Contract Drawings) made from the disc. 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.

1.36 EQUIPMENT AND SYSTEM O & M DEMONSTRATION & TRAINING

- .1 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.
- .2 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.

2 PRODUCTS

NOT APPLICABLE

3 EXECUTION

NOT APPLICABLE

END OF SECTION

1 GENERAL

1.01 APPLICATION

- .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.

1.02 SUBMITTALS

- .1 Submit the following for review:
 - .1 **shop drawings/product data sheets:** submit for:
 - .1 pressure gauges and thermometers;
 - .2 electric motors (submit with equipment they are associated with).
 - .3 Dampers and grilles
 - .2 **pipe & duct identification:** submit a list of pipe and duct identification colour coding and wording;
 - .3 **valve tag chart:** submit a proposed valve tag chart and a list of proposed valve tag numbering and identification wording;
 - .4 **additional submittals:** submit any other submittals specified in this Section or other mechanical work Sections of the Specification;

2 PRODUCTS

2.01 PIPE SLEEVES

- .1 **Galvanized Sheet Steel:** Minimum #16 gauge galvanized steel with an integral flange at one end to secure the sleeve to formwork construction.
- .2 **Polyethylene:** Factory fabricated, flanged, high density polyethylene sleeves with reinforced nail bosses.
- .3 **Galvanized Steel Pipe – Waterproof:** Schedule 40 mild galvanized steel pipe with a welded-on square steel anchor and water stop plate at the sleeve midpoint.
- .4 **Galvanized Steel or Cast Iron Pipe:** Schedule 40 mild galvanized steel, or Class 4000 cast iron.

2.02 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.

2.03 WATERPROOFING SEAL MATERIALS

- .1 Modular, mechanical seal assemblies consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and the pipe sleeve or wall opening, assembled with stainless steel bolts and pressure plates and designed so that when the bolts are tightened the links expand to seal the opening watertight. The seal assemblies are to be selected to suit the pipe size and the sleeve size or wall opening size. Acceptable products are:

- .1 Thunderline Corp. (Power Plant Supply Co.) "LINK SEAL" Model S-316;
- .2 The Metraflex Co. "MetraSeal" type ES.

2.04 PIPE ESCUTCHEON PLATES

- .1 One-piece chrome plated brass or #4 finish type 302 stainless steel plates with matching screws for attachment to the building surface, each plate sized to completely cover the pipe sleeve or building surface opening, and to fit tightly around the pipe or pipe insulation.

2.05 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 – Anvil Fig. 260 – MSS Type 1;
 - .2 adjustable swivel ring band type hanger – Anvil Fig. 69 – MSS Type 10;
 - .3 adjustable roller hanger – Anvil Fig's. 171, 177 & 181 – MSS Types 41, 43, and/or 45, with Anvil Fig. 160 to 166A – MSS Type 39 steel protection saddle
- .3 **Horizontal Pipe On Vertical Surfaces:** Epoxy coated steel pipe stays are not permitted. Supports are to be:
 - .1 steel offset pipe clamp – Anvil Fig. 103 or Myatt Fig. 170;
 - .2 heavy-duty steel pipe bracket – Anvil Fig. 262 or Myatt Fig. 161 – MSS Type 26;
 - .3 single steel pipe hook - Myatt Fig. 156;
- .4 **Floor Supports For Vertical Risers:** Supports are to be:
 - .1 copper tubing riser clamp – Anvil Fig. CT-121, Anvil Fig. CT-121C (plastic coated), or Myatt Fig. 150CT – MSS Type 8;
 - .2 heavy-duty steel riser clamp – Anvil Fig. 261, or Myatt Fig's. 182, 183, 190 and 191 – MSS Type 8.

- .5 **Vertical Piping on Vertical Surfaces:** Epoxy coated steel pipe stays are not permitted. Supports are to be:
 - .1 steel offset pipe clamp – Anvil Fig. 103 or Myatt Fig. 170;
 - .2 heavy-duty steel pipe bracket or soil pipe bracket – Anvil Fig. 262 or Myatt Fig. 161 – MSS Type 26;
 - .3 extension split pipe clamp – Anvil Fig's. 138R or Myatt Fig. 129 – MSS Type 12;
 - .4 **for piping on new roofs** – Lexcor "Flash-Tite" or Thaler Roofing Specialties Products Inc. "MERS" Series insulated aluminum support risers with diameter, height, securement method and flashing to suit the application, all required accessories, channel type aluminum cross members, and galvanized steel pipe hangers and/or supports conforming to MSS Type SP-58, complete with all required accessories;
 - .5 **for plastic piping** – generally as specified above but in accordance with the pipe manufacturer's printed recommendations;
 - .6 **for fire protection piping** – generally as above but ULC listed and/or FM approved, and in accordance with Chapter requirements of the NFPA Standard applicable to the piping system;
 - .7 **for bare horizontal copper piping** – generally as above but factory vinyl coated to prevent direct copper/steel contact;
 - .8 **for bare copper vertical piping** – corrosion resistant ferrous clamps with flexible rubber gasket type material (not tape) to isolate the pipe from the clamp;
- .6 **Hanger Rods:** Electro-galvanized carbon steel (unless otherwise specified), round, threaded, to ASTM A36, complete with captive machine nuts with washers at hangers, sized to suit the loading in accordance with Table 3 in MSS SP-58, but in any case minimum 9.5 mm (3/8") diameter.
- .7 **Acceptable Manufacturers:** Acceptable hanger and support material manufacturers are:
 - .1 E. Myatt & Co. Inc.;
 - .2 Anvil International Inc.;
 - .3 Empire Tool & Mfg. Co. Inc.;
 - .4 Hunt Manufacturing Ltd. ;
 - .5 Unistrut Canada Ltd.;
 - .6 Nibco Inc. "Tolco";
 - .7 Taylor Pipe Supports.

2.06 PRESSURE GAUGES AND THERMOMETERS

- .1 **Pressure Gauges:** Adjustable, glycerine filled, 100 mm or 115 mm (4" or 4½") diameter, each accurate to within 1% of scale range and complete with a type 304 stainless steel case with relief valve and polished stainless steel bayonet, stainless steel rotary movement with stainless steel bushings and socket, a clear acrylic window, 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, and black pointer. Acceptable products are:
 - .1 H. O. Trerice Co. Model 700 LFSS-40;
 - .2 Weiss Instruments Model LF4S-2;
 - .3 Ashcroft #35-1009 SWL-26.
- .2 **Pressure Gauge Accessories & Additional Requirements:** Accessories and additional requirements are as follows:
 - .1 a bronze ball type shut-off valve is to be provided in the piping to each pressure gauge;
 - .2 each pressure gauge for piping and equipment with normal everyday flow is to be equipped with a brass pressure snubber.
 - .3 pressure gauges in fire protection piping must be ULC listed and labelled.
 - .4 pressure gauges in medical gas piping systems are to conform to CSA Z7396.1 and are to be identified with the name of the service it is provided for as well as "USE NO OIL".
- .3 **Thermometers:** Round, 125 mm (5") diameter, adjustable (90°) angle bimetal dial type thermometers, each accurate to within 1% of full scale and complete with a hermetically sealed stainless steel case with stainless steel ring, dampened bimetal coil, calibration adjustment screw, 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, black aluminum pointer, double strength glass window, 12 mm (½") NPT connection with 6.4 mm (¼") diameter stainless steel stem, and a suitable thermowell. Acceptable products are:
 - .1 H.O. Trerice Co. B85600 Series;
 - .2 Weiss Instruments Model 5VBM25;
 - .3 Ashcroft #50EI60E-040-0/250.

2.07 EQUIPMENT BELT DRIVES

- .1 ANSI/RMA Standard V-belt type rated at minimum 1.5 times the motor nameplate rating, and in accordance with the following requirements:
 - .1 belts are to be reinforced cord and rubber, and multiple belts are to be matched sets;
 - .2 sheaves are to be cast iron or steel, secured to shafts with removable keys unless otherwise specified, standard adjustable pitch ($\pm 10\%$ range) for motors under 10 HP, fixed pitch type with split tapered bushing and keyway for motors 10 HP and larger, and, if required, replaced as part of the mechanical work to suit system air/water quantity testing and balancing work;
 - .3 motor slide rail adjustment plates are to allow for centre line adjustment.

- .2 Supply a spare belt set (tagged and identified) for each belt drive and hand to the Owner upon Substantial Performance of the work.

2.08 EQUIPMENT DRIVE GUARDS AND ACCESSORIES

- .1 **For V-belt drives** - removable, four sided, fully enclosed, galvanized sheet steel guards to OSHA standards, cleaned, factory primed and painted with yellow equipment enamel, complete with a 2-piece full length hinged front panel to permit belt maintenance or replacement without removing the guard, and 40 mm (1½") diameter tachometer openings at each shaft location.
- .2 **For flexible couplings** - removable "U" shaped galvanized steel guards to OSHA Standards with a 2.3 mm (3/32") thick frame and expanded mesh face.
- .3 **For unprotected fan inlets & outlets** - unless otherwise specified, removable 20 mm (¾") galvanized steel wire mesh with galvanized steel frames, all to OSHA Standards.

2.09 ELECTRIC MOTORS

- .1 Unless otherwise specified, motors are to conform to EEMAC Standard MG1, applicable IEEE Standards, and applicable CSA C22.2 Standards, and are to meet NEMA standards for maximum sound level ratings under full load. Confirm motor voltages prior to ordering.
- .2 Vertically mounted and submersible motors are to be purposely designed for mounting in this attitude.
- .3 **Motor Efficiency:** The efficiency of single phase motors to 1 HP is to be in accordance with CAN/CSA C747. The efficiency of all three phase motors 1 HP and larger is to be in accordance with CAN/CSA C390 or IEEE 112B.
- .4 **Single Phase Motors:** Unless otherwise specified, motors smaller than ½ HP are to be 115 volt, continuous duty capacitor start type with an EEMAC 48 or 56 frame size, solid base, heavy-gauge steel shell with solid die-cast end shields, dynamically balanced die-cast rotor, integral automatic reset thermal overload protection, Class "B" insulation, and a 1.15 service factor at 40°C (105°F) ambient temperature.
- .5 **Explosion-Proof Single Phase Motors:** Totally enclosed, fan cooled, 115 volt continuous duty capacitor start type in accordance with CSA C22.2 No. 145, as specified for standard single phase motors but suitable for use in Class 1 Group D hazardous locations and complete with a rolled steel shell and a 1.0 service factor at 40°C (105°C) ambient temperature.
- .6 **Three Phase Motors:** Unless otherwise specified, motors ½ HP and larger are to be totally enclosed, fan cooled, 3 phase, T-frame, squirrel cage continuous duty induction motors suitable for voltages indicated on the Drawings, EEMAC Design "B" for normal starting torque or Design "C" for high starting torque as required by the application, each complete with Class "B" insulation, a 1.5 service factor at 40°C ambient temperature, grease lubricated open ball bearings with grease fittings to permit re-lubrication without dismantling the motor, a cast iron frame with cast iron feet where required, cast iron end bracket and precision machined bearing fit, and balanced carbon steel shaft assembly with die-cast aluminum rotor windings.
- .7 **Explosion-Proof Three Phase Motors:** Totally enclosed fan cooled motors in accordance with CSA C22.2 No. 145, generally as specified above for standard 3 phase motors but suitable for use in Class 1 Group D hazardous locations and with a 1.0 service factor at 40°C (105°C) ambient temperature.

- .8 **Two-Speed Double Wind Motors:** The motor(s) for two-speed fan(s) are to be as above but two-speed double winding type.
- .9 **Thermistor Protection:** Unless otherwise indicated, motors 30 HP and larger are to be complete with a heat sensing PTC thermistor in the end turn of the stator winding for each phase and connected in series inside the motor with two marked leads brought out to the motor conduit box.
- .10 **Motors for VFD's:** Motors for equipment with variable frequency drives are to be generally as specified above but inverter duty type to NEMA Standard MG-1 Part 31, quantified by CSA for operation from a variable frequency drive of the type specified, and complete with Class "H" insulation. Motors are to be equipped with AEGIS, or approved equal, shaft grounding ring system to protect bearings from damage by diverting harmful shaft voltages and bearing currents to ground.
- .11 **Acceptable Manufacturers:** Acceptable motor manufacturers are:
 - .1 Westinghouse Canada Inc.;
 - .2 Canadian General Electric;
 - .3 Baldor Electric Co.;
 - .4 U.S. Electrical Motors;
 - .5 Weg Electric Corp.;
 - .6 Marathon Electric;

2.10 MOTOR STARTERS AND ACCESSORIES

- .1 **General:** All motor starters must be capable of starting the associated motors under the imposed loads. Confirm that starter voltage matches the motor prior to ordering.
- .2 **Starters For Single Phase Motors:** Unless otherwise specified, starters for single phase motors are to be 115 volt, thermal overload protected manual starting switches with a neon pilot light, a surface or recessed enclosure to suit the application, and, where automatic operation is required, a separate "hand-off-automatic" switch in an enclosure to match the starter enclosure.
- .3 **Starters For Three Phase Motors Less Than 50 HP:** Unless otherwise specified, starters for three phase motors less than 50 HP are to be combination "quick-make" and "quick-break" fused disconnects and full voltage non-reversing across-the-line starters, each complete with and overload relay per phase, an enclosure to suit the application, and, a "hand-off-automatic" switch, pilot lights, control transformer, auxiliary contacts, and other accessories as per the motor starter schedule.
- .4 **Starters For Three Phase Motors 50 HP to 150 HP:** Unless otherwise specified, starters for three phase motors 50 HP to 150 HP are to be reduced voltage, non-reversing, auto-transformer type starters complete with one overload relay per phase, an enclosure to suit the application, and, a "hand-off-automatic" switch, pilot lights, control transformer, auxiliary contacts, and other accessories as per the motor starter schedule.

- .5 **Starters For Three Phase Motors 150 HP and Larger:** Unless otherwise specified, starters for three phase motors 150 HP and larger are to be reduced voltage, non-reversing, closed transition "wye-delta" starters complete with one overload relay per phase, an enclosure to suit the application, and, a "hand-off-automatic" switch, pilot lights, control transformer, auxiliary contacts, and other accessories as per the motor starter schedule.
- .6 **Starters For 2-Speed Double Winding Motors:** Generally as specified above but suitable for the motor and equipped with a 45 second time delay to permit the equipment to coast down to low speed before it is operated at low speed.
- .7 **Starters For 2-Speed Single Winding Motors:** Generally as specified above but suitable for the motor and equipped with a 45 second time delay to permit the equipment to coast down to low speed before it is operated at low speed.
- .8 **Starters For Reversible Motors For Cooling Towers:** Generally as specified above but suitable for the motor and equipped with a 45 second time delay to allow the fan(s) to coast down to a stop before being operated in reverse rotation.
- .9 **Motor Starter Enclosures:** Unless otherwise specified, motor starter enclosures are to be in accordance with the following NEMA/EEMAC ratings:
 - .1 all enclosures located in sprinklered areas – Type 2;
 - .2 all enclosures exposed to the elements – Type 3R, constructed of stainless steel;
 - .3 all enclosures inside the building in wet areas – Type 3R, constructed of stainless steel;
 - .4 all enclosures in explosion rated area – Type 7 with exact requirements to suit the area and application;
 - .5 all enclosures except as noted above – Type 1;
 - .6 all enclosures located in finished areas – as above but recess type with brushed stainless steel faceplate.
- .10 **Motor Control Centres:** Multi-unit, 2.28 m (9') high, EEMAC Class 1, type "B", factory assembled, dead front, floor mounted, free-standing motor control centre with tin plated copper bus and an EEMAC Type 1 or Type 2 enclosure as for loose starters specified above. Each motor control centre is to be complete with starters as specified above, load and control wiring terminal boards, and all required facilities for line and load side power wiring connections.
- .11 **Disconnect Switches For Motor Control Centres:** Heavy-duty, CSA certified, front operated switches as per the motor starter schedule, each complete with a handle suitable for padlocking in the "off" position and arranged so that the door cannot be opened with the handle in the "on" position and an EEMAC enclosure as specified for loose starters. Fusible units are to be complete with fuse clips to suit fuse types specified below.
- .12 **Fuses:** Unless otherwise scheduled or specified, English Electric Ltd. HRC fuses, Form I Class "J" for constant running equipment and Form II Class "C" for equipment that cycles on and off.
- .13 **Acceptable Manufacturers:** Acceptable manufacturers are:
 - .1 Rockwell Automation Inc. - Allen-Bradley;

- .2 Eaton Corp. – Cutler-Hammer;
- .3 Eaton Corp. – Moeller Electric;
- .4 Siemens Canada;
- .5 Schneider Electric.

2.11 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 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.:

VALVE V12
200 mm (8")
CHILL. WATER
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
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PIPE SERVICE	IDENTIFICATION COLOUR	LEGEND
domestic cold water	green	DOM. COLD WATER
domestic hot water supply	green	DOM. HW SUPPLY
domestic hot water recirculation	green	DOM. HW RECIRC.
tempered domestic water	green	TEMP. DOM. WATER
storm drainage	green	STORM
sanitary drainage	green	SAN.
plumbing vent	green	SAN. VENT
fire protection standpipe	red	F.P. STANDPIPE
fire protection sprinklers	red	F.P. SPRINKLER
natural gas	to Code	to Code, c/w pressure
natural gas vent	to Code	to Code
propane gas	to Code	to Code, c/w pressure
propane gas vent	to Code	to Code
fuel oil supply	yellow	FUEL OIL SUPPLY
fuel oil return	yellow	FUEL OIL RETURN
fuel oil vent	yellow	FUEL OIL VENT
heating water supply	yellow	HTG. WTR. SUPPLY
heating water return	yellow	HTG. WTR. RETURN
heating water drain	yellow	HTG. WTR. DRAIN
glycol heating supply	yellow	GLY. HTG. SUPPLY
glycol heating return	yellow	GLY. HTG. RETURN
glycol heating drain	yellow	GLY. HTG. DRAIN
condenser water supply	green	COND. WTR. SUPPLY
condenser water return	green	COND. WTR. RETURN
chilled water supply	green	CH. WTR. SUPPLY
chilled water return	green	CH. WTR. RETURN
chilled water drain	green	CH. WTR. DRAIN
boiler feedwater	yellow	BLR. FEEDWATER
boiler blowdown	yellow	BLR. BLOW-OFF
refrigerant suction	yellow	REFRIG. SUCTION
refrigerant liquid	yellow	REFRIG. LIQUID
refrigerant hot gas	yellow	REFRIG. HOT GAS
diesel engine exhaust	yellow	ENGINE EXHAUST
gasoline	yellow	GASOLINE

- .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

2.12 FLEXIBLE CONNECTORS

- .1 Double wall stainless steel flexible connectors for piping connections to vibration isolated equipment, each selected by the manufacturer to suit the application. Shop drawings or product data sheets must indicate construction and performance requirements that suit the application. Acceptable manufacturers are:
- .1 Hyspan Precision Products Inc.;
 - .2 Senior Flexonics Ltd.;
 - .3 The Metraflex Co..

3 EXECUTION

3.01 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 **Manufacturer's Instructions:** Ensure that equipment and material manufacturer's installation instructions are followed unless otherwise specified herein or on the drawings, and unless such instructions contradict governing codes and regulations.

- .8 **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.
- .9 **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.
- .10 **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.
- .11 **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.
- .12 **Drain Pans:** Provide continuous galvanized sheet metal drip pan under all drain, water and water solution piping extending through all rooms with electrical equipment such as electrical, elevator equipment and transformer rooms, and all other spaces provided primarily for the installation of electrical equipment. Drip pans are to be complete with a drain pipe connection and drain piping is to be extended to the closest drain.
- .13 **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.
- .14 **Work In High Humidity Areas:** Where mechanical work is located in high humidity areas where ferrous metal products will be subject to corrosion and protection for such products is not specified, provide finishes on the products to protect against corrosion or provide products which will not corrode in the environment, i.e. aluminium ductwork, copper or stainless steel pipe, etc.
- .15 **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 long (in excess of 12 m/40') piping runs to permit removal of sections of piping.
- .16 **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.

3.02 INSTALLATION OF PIPE SLEEVES

- .1 Where pipes pass through concrete and/or masonry surfaces provide pipe sleeves as follows:
 - .1 **in poured concrete slabs:** unless otherwise specified - minimum 16 gauge flanged galvanized steel or, where permitted by governing authorities, factory fabricated plastic sleeves;
 - .2 **in concrete or masonry walls:** Schedule 40 galvanized steel pipe or Class 4000 cast iron pipe.

- .2 **Waterproof Sleeves:** Sleeves in waterproofed slabs or walls are to be lengths of Schedule 40 mild galvanized steel pipe with a waterstop plate in accordance with the drawing detail. Provide waterproof sleeves in the following locations:
 - .1 in mechanical room floor slabs, except where on grade;
 - .2 in slabs over mechanical, fan, electrical and telephone equipment rooms or closets;
 - .3 in all floors equipped with waterproof membranes;
 - .4 in the roof slab;
 - .5 in waterproof walls.
- .3 Size sleeves, unless otherwise specified, to leave 12 mm ($\frac{1}{2}$ ") clearance around the pipes, or where the pipe is insulated, a 12 mm ($\frac{1}{2}$ ") clearance around the pipe insulation.
- .4 Pack and seal the void between the pipe sleeves and the pipe or pipe insulation in non-fire rated construction for the length of the sleeves as follows:
 - .1 **interior construction:** pack sleeves in interior construction with mineral wool and seal both ends of the sleeves with non-hardening silicone base caulking compound;
 - .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.
- .5 Where sleeves are required in masonry work, accurately locate and mark the sleeve location, and hand the sleeves to the mason for installation.
- .6 Terminate piping for sleeves that will be exposed so that the sleeve is flush at both ends with the building surface concerned so that the sleeve may be completely covered by an escutcheon plate, except for sleeves in waterproof floors which are to terminate 100 mm (4") above the finished floor.
- .7 "Gang" type sleeving will not be permitted.

3.03 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.

3.04 DUCT OPENINGS

- .1 Duct openings, air inlet and outlet openings, fire damper and similar openings will be provided in new poured concrete work, masonry, drywall and other building surfaces by the trade responsible for the particular construction in which the opening is required.

- .2 Ensure that openings for fire dampers to 600 mm (24") high are sized to suit the damper arrangement with the folding blade out of the air stream.
- .3 For all duct openings except where fire dampers are required, pack and seal the space between the duct or duct insulation and the duct opening as specified above for pipe openings in non-fire rated construction.

3.05 SLEEVE AND FORMED OPENING LOCATION DRAWINGS

- .1 Prepare and submit for review, white print drawings indicating the size and location of all required sleeves, recesses and formed openings in poured or precast concrete work.
- .2 Such drawings are to be completely and accurately dimensioned and relate sleeve, recesses, and formed openings to suitable grid lines and elevation datum, and are to take into account structural items such as grade beams, column caps, and column drop slabs
- .3 Begin to prepare such drawings immediately upon notification of acceptance of bid and award of Contract.

3.06 INSTALLATION OF PIPE ESCUTCHEON PLATES

- .1 Provide escutcheon plates suitable secured over all exposed piping passing through finished building surfaces. A finished building surface is any surface with a factory finish or that receives a site applied finish.
- .2 Install the plates so that they are tight against the building surface concerned, and ensure that the plates completely cover pipe sleeves and/or openings, except where waterproof sleeves extend above floors, in which case the plate is to fit tightly around the sleeve.

3.07 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.
- .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.

3.08 INSTALLATION OF PIPE HANGERS AND SUPPORTS

- .1 Provide all required pipe hangers and supports.
- .2 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.
- .3 **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.

- .4 **Underground Piping:** Support requirements for underground piping are as follows:
- .1 support underground pipe located in accordance with the drawing detail;
 - .2 support underground pipe, unless otherwise specified, on a well compacted bed of dry, natural, undisturbed earth free from rocks or protrusions of any kind, or on compacted material as specified;
 - .3 support underground service piping penetrating building exterior walls or foundations to prevent pipe damage if minor building settlement occurs, all as per the drawing detail;
 - .4 ensure that all bedding and supports for underground pipes are flat and true and that allowances are made for pipe hubs, couplings, or other protrusions so that no voids are left between the pipe and the bedding;
- .5 **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") dia. are to be clevis type or adjustable ring type, and hangers for suspended pipe 40 mm (1½") dia. 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 **glass pipe:** conform to pipe manufacturer's recommended support spacing and support requirements;
 - .4 **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')	

- .5 **flexible grooved pipe/coupling joint piping:** as above but with not less than one hanger or support between joints;
- .6 **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;

- .7 **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;
 - .8 **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.
- .6 **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 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.
- .7 **Piping On The Roof:** Support piping on the roof in accordance with requirements of the drawing detail.

3.09 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.

3.10 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);
 - .4 in separate domestic hot water storage tank(s);
 - .5 at the top most outlet in each standpipe fire protection system riser;
 - .6 in piping at each side of a pressure reducing valve;
 - .7 in potable water service piping downstream of the meter;
 - .8 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, heat exchangers, main coils, etc., unless temperature indication is supplied with the equipment;
 - .2 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.

3.11 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.

3.12 MECHANICAL WORK IDENTIFICATION

- .1 **Exposed Piping & Ductwork:** Identify new exposed piping and ductwork as per Part 2 of this Section in locations 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, unless otherwise specified;
 - .5 at 6 m (20') intervals on pipe and duct runs exceeding 6 m 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.
- .2 **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..
- .3 **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.
- .4 **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 9. Identify the piping at intervals as specified above.
- .5 **Motor Starters and Disconnect Switches:** Provide an identification nameplate for each new motor starter or disconnect switch located in a motor control centre or on a motor starter panel, and on each individually mounted starter which you supply, and on each disconnect switch provided as part of the electrical work for motorized equipment which you provide.
- .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 frame and glaze one copy of the chart and, unless otherwise directed, affix to a wall in each main Mechanical and/or Equipment Room;
- .4 include a copy of the valve tag chart in each copy of the operating and maintenance instruction manuals;
- .5 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

3.13 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.
- .4 **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 two 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 two hours with zero leakage.
- .5 **Pumped Drainage Piping:** Test piping with cold water at a pressure of 1½ times normal working pressure and maintain the pressure for a minimum of two hours.
- .6 **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 two hours.

- .7 **Natural Gas Piping:** Test piping in accordance with the requirements of CAN/CSA - B149.1. After completion of the verification test, locate the required tag stating the results of the verification test at the point of entry of the gas main into the building, affixed to the pipe in a secure manner. Check all piping joints and connections for leaks with a water/soap solution while the piping is under pressure.
- .8 **Propane Gas Piping:** Test piping in accordance with the requirements of CAN/CSA - B149.2. After completion of the verification test, locate the required tag stating the results of the verification test at the point of entry of the gas main into the building, affixed to the pipe in a secure manner. Check all piping joints and connections for leaks with a water/soap solution while the piping is under pressure.
- .9 **Refrigerant Piping:** Test refrigerant piping for leakage and dehydrate in accordance with requirements of Chapter 18 of the ASHRAE HANDBOOK - FUNDAMENTALS.
- .10 **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 hydrostatic 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.

3.14 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.
- .2 Unless otherwise shown or specified, supply a starter for each item of motorized equipment you provide. Refer to the drawing Motor Starter Schedule.

- .3 **Three Phase Motor Starters on Motor Starter Panels:** Where three phase starters are indicated and/or scheduled to be mounted on a motor starter panel, the starters will be mounted and connected, complete with the panels and splitter trough, as part of the electrical work. Hand the starters to the electrical trade at the site when they are required.
- .4 **Disconnect Switches on Motor Starter Panels:** Where package type equipment with integral starters, or equipment with starters integral in loose power and control panels supplied with the equipment is fed from a motor starter panel, a disconnect switch will be provided on the motor starter panel as part of the electrical work
- .5 **Single Phase Motor Starters:** Unless otherwise specified or shown on the drawings, single phase motor starters will be mounted adjacent to the equipment they serve and connected complete as part of the electrical work. Hand the starters to the electrical trade at the site at the proper time.

3.15 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.

3.16 EQUIPMENT BASES AND SUPPORTS

- .1 **Concrete Housekeeping Pads:** Unless otherwise specified or required, set all floor mounted equipment on minimum 100 mm (4") high reinforced concrete housekeeping pads 200 mm (8") clear of the equipment on each side and end, or a minimum of 200 mm (8") from the centreline of equipment anchor bolts to the edge of the base, whichever is larger. Conform to the following requirements:
 - .1 supply dimensioned drawings and equipment base templates, and provide anchor bolts for proper setting and securing of equipment on pads;
 - .2 place anchor bolts during the concrete pour and be responsible for all required levelling, alignment, and grouting of the equipment;
 - .3 as a minimum, use wire mesh reinforcement, however, for pads for large heavy equipment, use reinforcement as per structural drawing details.
- .2 **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 conforming to the following requirements:
 - .1 all stands and supports, except those for small equipment, are to be designed by a structural engineer registered in the jurisdiction of the work, and stamped and signed design drawings with calculations are to be submitted as shop drawings for review;
 - .2 all steel stands are to be flange bolted to concrete housekeeping pads;
 - .3 all stands and supports are to be seismically restrained in accordance with applicable requirements.

3.17 MECHANICAL SERVICE REQUIREMENTS FOR FLOATING FLOOR SLABS

- .1 Where mechanical services are required to be installed in or through a vibration isolated floating slab, install such services so as not to transmit any vibration to the base slab on which the floating floor slab is placed.
- .2 Wherever possible arrange mechanical work to avoid penetrating a floating floor slab.

3.18 EXCAVATION AND BACKFILL WORK

- .1 Excavation, backfill and related work such as dewatering required for mechanical work will be performed as part of the excavation and backfill work, except for final hand grading work which is to be done as part of the mechanical work.
- .2 Inverts and locations of existing site services have been shown on the drawings. The inverts and locations shown are approximate, and it is your responsibility to confirm and satisfy yourself that the inverts and locations as shown are correct, prior to commencing site service work.
- .3 Accurately mark-out the location and routing of excavation required for your work, as well as the required depth.
- .4 Ensure that all underground piping subject to freezing and located outside the building has a minimum of 1.37 m (4½') of cover.
- .5 Ensure that all underground piping subject to freezing and located inside the building in unheated areas has a minimum of 450 mm (18") of cover.

- .6 Ensure that pipe bedding is proper prior to laying pipes. Hand excavate under pipe hubs, couplings, flanges and similar items to ensure even bearing along the entire barrel of each length of pipe.
- .7 Ensure that piping is inspected, leakage tested and approved prior to backfilling. Supervise the initial backfilling operation to ensure that the buried work is not disturbed.

3.19 EXCAVATION AND BACKFILL WORK

- .1 Do all excavation, backfill and related work required for your work. Perform such work in accordance with requirements of the Excavation and Backfill work Section, except as modified by this Article. Obtain a copy of the soil test report and review during the bidding period.
- .2 Grade the bottom of trench excavations as required.
- .3 In firm, undisturbed soil, lay pipes directly on the soil, unless otherwise directed.
- .4 Unless otherwise specified, backfill trenches within the building with clean sharp sand in individual layers of maximum 150 mm (6") thickness compacted to a density of 100% Standard Proctor. Hand compact the first layers up to a compacted level of minimum 300 mm (12") above the top of the pipe. Hand or machine compact the balance up to grade.
- .5 Unless otherwise specified, backfill trenches outside the building (not under roads, parking lots or traffic areas), up to a compacted level of 450 mm (18") thick above the pipe, hand compacted to a density of 95% Standard Proctor, using granular "A" gravel. Backfill the balance in 150 mm (6") layers with approved excavated material, compacted to 95% Standard Proctor density.
- .6 Unless otherwise specified, backfill trenches outside the building under roads, parking lots or traffic areas with crushed stone or granular "A" gravel in layers not exceeding 150 mm (6") thickness, compacted to 100% Standard Proctor density up to grade level.

3.20 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 Prior to drilling or cutting an opening in poured concrete construction, determine the location, if any, of existing services concealed in the construction to be drilled or cut. X-ray or Ferro Scan Test the walls or slabs if required.
- .5 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.

3.21 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.

3.22 USE OF MECHANICAL SYSTEMS FOR TEMPORARY HEATING

- .1 Permanent building mechanical systems are not to be used for temporary heating purposes during construction.
- .2 Permanent mechanical systems in the building may be used for temporary heating during construction subject to the following conditions:
 - .1 each entire system is complete, pressure tested, cleaned, and flushed out;
 - .2 specified water treatment system has been commissioned, and treatment is being continuously monitored;
 - .3 building has been closed in and areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes;
 - .4 there is no possibility of damage from any cause;
 - .5 supply ventilation systems are protected by 60% filters, which are to be inspected daily, and changed every 2 weeks, or more frequently as required;
 - .6 return air systems have approved construction filters over all openings, inlets, and outlets;
 - .7 all systems are operated as per the manufacturer's recommendations or instructions, and are monitored on a regular and frequent basis;
 - .8 warranties are not affected in any way;
 - .9 regular preventive and all other manufacturer's recommended maintenance routines are performed;
 - .10 before Substantial Performance, each entire system is to be refurbished, cleaned internally and externally, restored to "as-new" condition, and filters in air systems replaced;
 - .11 energy costs are to be paid by the Contractor.

3.23 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.

3.24 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.

3.25 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with requirements specified in Division 01.
- .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.
- .3 Prepare a waste management and reduction plan and submit a copy for review prior to work commencing at the site.
- .4 Place materials defined as hazardous or toxic waste in designated containers.
- .5 Ensure emptied containers are sealed and stored safely for disposal.

3.26 INSTALLATION OF FLEXIBLE CONNECTORS

- .1 Provide flexible connectors in piping connections to all seismically restrained equipment, and wherever else shown.
- .2 Provide flexible connectors in all piping connections to vibration isolated equipment.

3.27 FAN NOISE LEVELS

- .1 Submit sound power levels with fan shop drawings/product data, with levels measured to AMCA 300 and calculated to AMCA 301.

END OF SECTION

1 GENERAL

1.01 APPLICATION

- .1 This Section specifies insulation 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.

1.02 SUBMITALS

- .1 **Product Data Sheets:** Submit a product data sheet for each insulation system product.
- .2 **Fire Rated Duct Wrap Certification Letter:** As per Part 3 of this Section, submit a letter from the fire rated duct wrap supplier to certify that the duct wrap has been properly installed.

1.03 QUALITY ASSURANCE

- .1 Mechanical insulation is to be applied by a licensed journeyman insulation mechanic, or by an apprentice under direct, daily, on-site supervision of a journeyman mechanic.
- .2 Ensure that all surfaces to be insulated are clean and dry.
- .3 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.

2 PRODUCTS

2.01 FIRE HAZARD RATINGS

- .1 Unless otherwise specified, all insulation system materials inside the building 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.

2.02 THERMAL PERFORMANCE

- .1 Unless otherwise specified, thermal performance of insulation is to meet or exceed the values given in Tables 6.8.2.A, 6.8.2.B, 6.8.3.A and 6.8.3.B of ASHRAE/IES Standard 90.1.

2.03 PIPE INSULATION MATERIALS

- .1 **Horizontal Pipe Insulation at Hangers & Supports:** Equal to Belform Insulation Ltd. "Koolphen K-Block" insulated pipe support inserts consisting of minimum 150 mm (6") long, premoulded, rigid, sectional phenolic foam insulation (of same thickness as adjoining insulation) with a reinforced foil and kraft paper vapour barrier jacket and a captive galvanized steel saddle.
- .2 **Flexible Foam Elastomeric:** Closed cell, sleeve type, longitudinally split self-seal, foamed plastic pipe insulation with a water vapour transmission rating of 0.10 in accordance with ASTM E96-90, Procedure B, and all required installation accessories. Acceptable products are:

- .1 Armacell AP/Armaflex SS;
- .2 IK Insulation Group K-Flex "LS" Self-Seal Pipe Insulation.
- .3 **Semi-Rigid Mineral Wool Blanket:** Equal to Roxul "Enerwrap80" flexible, black fibrous scrim faced mineral wool blanket insulation to ASTM C 553.
- .4 **Premoulded Mineral Fibre:** Rigid, sectional, sleeve type insulation to ASTM Standard C 547-00, with a factory applied vapour barrier jacket. Acceptable products are:
 - .1 Johns Manville Inc. "Micro-Lok AP-T Plus";
 - .2 Knauf Fiber Glass "Pipe Insulation" with "ASJ-SSL" jacket;
 - .3 Manson Insulation Inc. "ALLEY K APT";
 - .4 Owens Corning Fiberglas Pipe Insulation.
- .5 **Blanket Mineral Fibre:** Blanket type roll insulation to CGSB 51-GP-11M, 24 kg/m³ (1½ lb./ft.³) density, with a factory applied vapour barrier facing. Acceptable products are:
 - .1 Johns Manville Inc. Microlite FSK Duct Wrap Type 150;
 - .2 Knauf Fiber Glass Blanket Insulation FSK Duct Wrap Type III;
 - .3 Manson Insulation Inc. ALLEY WRAP FSK Duct Wrap Type III;
 - .4 Certainteed Corporation Softtouch FSK Duct Wrap Type 150.

2.04 EQUIPMENT INSULATION MATERIALS

- .1 **Semi-Rigid Mineral Fibre Board:** Roll form, moulded insulation to ASTM Standard C1393-00a, with a factory applied vapour barrier facing consisting of laminated aluminum foil and kraft paper. Acceptable products are:
 - .1 Knauf Fiber Glass Pipe and Tank Insulation;
 - .2 Manson Insulation Inc. "AK FLEX";
 - .3 Johns Manville Inc. Pipe and Tank Insulation "Micro-Flex";
 - .4 Multi-Glass Insulation Ltd. "MULTI-FLEX MF";
 - .5 Owens Corning Pipe and Tank Insulation;
 - .6 Glass-Cell Fabricators Ltd. "R-Flex".

2.05 DUCTWORK SYSTEM INSULATION MATERIALS

- .1 **Rigid Mineral Fibre Board:** Preformed board type insulation to ASTM C612-00a, 48 kg/m³ (3.0 lb./ft.³) density, with a factory applied reinforced aluminum foil and kraft paper facing. Acceptable products are:

- .1 Knauf Fiber Glass Insulation Board with FSK facing;
- .2 Manson Insulation Inc. "AK BOARD FSK";
- .3 Johns Manville Inc. Type 814 "Spin-Glas";
- .4 Owens Corning 703.
- .2 **Semi-Rigid Mineral Fibre Board:** Roll form insulation to ASTM Standard C1393 00a, consisting of cut strips of rigid mineral board insulation glued to an aluminium foil and kraft paper facing. Acceptable products are:
 - .1 Multi-Glass Insulation Ltd. "Multi-Flex MKF";
 - .2 Glass-Cell Fabricators Ltd. "R-FLEX";
 - .3 Owens Corning Pipe and Tank Insulation;
 - .4 Johns Manville Inc. Pipe and Tank Insulation.
- .3 **Blanket Mineral Fibre:** Blanket type roll form insulation to ASTM Standard C553-00, 24 kg/m³ (1½ lb./ft.³) density, 40 mm (1½") thick, with a factory applied vapour barrier facing. Acceptable products are:
 - .1 Johns Manville Inc. Microlite FSK Duct Wrap Type 150;
 - .2 Knauf Fiber Glass Blanket Insulation FSK Duct Wrap Type III;
 - .3 Manson Insulation Inc. ALLEY WRAP FSK Duct Wrap Type III;
 - .4 Certainteed Corporation Softtouch FSK Duct Wrap Type 150.
- .4 **Flexible Foam Elastomeric Sheet:** Sheet form, CFC free, closed cell, self-adhering elastomeric nitrile rubber insulation with a water vapour permeability rating of 0.08 in accordance with ASTM E96 Procedure A. Acceptable products are:
 - .1 Armacell "AP/Armaflex SA";
 - .2 IK Insulation Group "K-Flex Duct Wrap", S2S.

2.06 FIRE RATED DUCT WRAP

- .1 Flexible, non-combustible, blanket type mineral fibre duct wrap completely encapsulated in reinforced foil, 40 mm (1½") thick, suitable for installation with zero clearance to combustibles, and ULC tested and listed (ULC Designs FRD-3 & 5 for ventilation ducts, ULC Design FRD-4 for kitchen exhaust duct) to facilitate a 1 or 2 hour fire resistance rating to kitchen grease exhaust duct in accordance with requirements of NFPA-96, and/or a 1 or 2 hour fire resistance rating to ventilation or pressurization ductwork in accordance with requirements of ISO 6944.
- .2 Acceptable manufacturers are:
 - .1 3M Fire Barrier Duct Wrap 615+;
 - .2 CL4 Inc. "CL4Fire";

- .3 Unifrax Corp. "FyreWrap Elite 1.5";

2.07 INSULATING COATINGS

- .1 Equal to Robson Thermal Manufacturing Ltd. insulating coatings as follows:
 - .1 anti-condensation coating, "No Sweat-FX";
 - .2 thermal insulating coating, "ThermaLite".

2.08 INSULATION FASTENINGS

- .1 **Wire:** Minimum #15 gauge galvanized annealed wire.
- .2 **Wire Mesh:** Minimum #15 gauge galvanized annealed wire factory woven into 25 mm (1") hexagonal mesh.
- .3 **Aluminium Banding:** Equal to ITW Insulation Systems Canada "FABSTRAPS" minimum 12 mm (½") wide, 0.6 mm (1/16") thick aluminium strapping.
- .4 **Duct Insulation Fasteners:** Weld-on 2 mm (3/32") diameter zinc coated steel spindles of suitable length, complete with minimum 40 mm (1½") square plastic or zinc plated steel self-locking washers.
- .5 **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.
- .6 **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.
- .7 **Adhesive – Flexible Elastomeric Insulation:** Armacell "Armaflex" #520 air-drying contact adhesive.
- .8 **Adhesive – Closed Cell Foamed Glass Insulation:** Pittsburgh Corning PC88 multi-purpose two-component adhesive.

2.09 INSULATION JACKETS AND FINISHES

- .1 **Canvas:** ULC listed and labelled, 25/50 rated, roll form, minimum 170 g (6 oz.) canvas jacket material.
- .2 **White PVC:** Roll form sheet and fitting covers, minimum 15 mil thick white PVC, 25/50 rated, complete with installation and sealing accessories. Acceptable products are:
 - .1 Proto Corp. "LoSMOKE";
 - .2 The Sure-Fit System "SMOKE-LESS 25/50";
 - .3 Johns Manville Inc. "Zeston" 300.

- .3 **Rigid Aluminium:** Equal to ITW Insulation Systems Canada "Lock-on" 0.406 mm (0.016") thick embossed aluminum jacket material to ASTM B209, factory cut to size and complete with polysurlyn moisture barrier and continuous modified Pittsburgh Z-Lock, and "Fabstraps" and butt straps with weatherproof the end to end joints. Fittings are to be two-piece epoxy coated pressed aluminum with weather locking edges.

3 EXECUTION

3.01 GENERAL INSULATION APPLICATION REQUIREMENTS

- .1 Unless otherwise specified, do not insulate the following:
 - .1 factory insulated equipment and piping;
 - .2 heating piping within radiation unit enclosures, including blank filler sections of enclosures;
 - .3 heating piping in soffits and/or overhang spaces and connected to bare element radiation in the spaces;
 - .4 branch potable water piping located under counters to serve counter mounted plumbing fixtures and fittings, except barrier-free lavatories;
 - .5 exposed chrome plated potable water angle supplies from concealed piping to plumbing fixtures and fittings, except barrier-free lavatories;
 - .6 heated liquid system pump casings, valves, strainers and similar accessories;
 - .7 heating system expansion tanks;
 - .8 fire protection pump casings;
 - .9 manufactured expansion joints and flexible connections;
 - .10 acoustically lined ductwork and/or equipment;
 - .11 fire protection system water storage tanks;
 - .12 piping unions, except for unions in "cold" category piping.
- .2 Install insulation directly over pipes and ducts and not over hangers and supports.
- .3 Install piping insulation and jacket continuous through pipe openings and sleeves.
- .4 Install duct insulation continuous through walls, partitions, and similar surfaces except at fire dampers.
- .5 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.
- .6 When insulating vertical piping risers 75 mm diameter and larger, use insulation support rings welded directly above the lowest pipe fitting, and thereafter at 4.5 m centres and at each valve and flange. Insulate as per Thermal Insulation Association of Canada National Insulation Standards, Figure No. 9.

- .7 Where piping and/or equipment is traced with electric heating cable, ensure that the cable has been tested and accepted prior to the application of insulation, and ensure that the cable is not damaged or displaced during the application of insulation.
- .8 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.
- .9 Carefully and neatly gouge out insulation for proper fit where there is interference between weld bead, mechanical joints, etc., and insulation. Bevel away from studs and nuts to permit their removal without damage to insulation, and closely and neatly trim around extending parts of pipe saddles.
- .10 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.

3.02 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.

3.03 PIPE INSULATION REQUIREMENTS - MINERAL FIBRE

- .1 Insulate the following pipe inside the building and above ground with mineral fibre insulation of the thickness indicated:
 - .1 domestic cold water piping to and including 100 mm (4") dia. – 25 mm (1") thick;
 - .2 domestic cold water piping larger than 100 mm (4") dia. – 40 mm (1½") thick;
 - .3 domestic hot water piping, to and including 40 mm (1½") dia. – 25 mm (1") thick;
 - .4 domestic hot water piping, larger than 40 mm (1½") dia. – 40 mm (1½");
 - .5 tempered domestic water piping, supply and return, to and including 40 mm (1½") dia. – 25 mm (1") thick;
 - .6 tempered domestic water piping, supply and return, larger than 40 mm (1½") dia. – 50 mm (2") thick;
 - .7 storm drainage piping from roof drains to the point where main vertical risers extend straight down, without offsets, and connect to horizontal underground mains - 25 mm (1") thick;
 - .8 condensate drainage piping from fan coil unit or any other air conditioning system/unit drain pans to main vertical drain risers or to indirect drainage point – 25 mm (1") thick;
 - .9 drainage piping from refrigerated drinking fountains to nearest 75 mm (3") dia. or larger drain pipe – 25 mm (1") thick;

- .10 chilled water piping, supply and return, to and including 100 mm (4") dia – 25 mm (1") thick;
- .11 chilled water piping, supply and return, larger than 100 mm (4") dia. – 40 mm (1½") thick;
- .12 chilled glycol solution piping, supply and return, to and including 100 mm (4") dia. – 25 mm (1") thick;
- .13 chilled glycol solution piping, supply and return, larger than 100 mm (4") dia. – 40 mm (1½") thick;
- .14 hot water heating piping, supply and return, to 40 mm (1½") dia. – 40 mm (1½") thick;
- .15 hot water heating piping, supply and return, 40 mm (1½") dia. and larger – 50 mm (2") thick;
- .16 glycol solution heating or heat reclaim piping, supply and return, to 40 mm (1½") dia. – 40 mm (1½") thick;
- .17 glycol solution heating or heat reclaim piping, supply and return, 40 mm (1½") dia. and larger – 50 mm (2") thick;
- .18 boiler feedwater piping complete – 25 mm (1") thick;
- .19 boiler blowdown piping complete – 40 mm (1½") thick;
- .20 chilled domestic cold water piping from remote water cooler(s) to drinking fountain(s) – 40 mm (1½") thick;
- .21 all piping as above located inside building in unheated areas and indicated to be traced with electric heating cable – minimum 50 mm (2") thick;
- .22 drum drip(s) in dry zone standpipe and/or sprinkler system piping – 50 mm (2") thick;
- .23 refrigerant suction piping (between compressor and evaporator coil) inside building – 25 mm (1") thick;
- .24 refrigerant hot gas piping (between compressor and condenser) inside building – 25 mm (1") thick;
- .25 refrigerant hot gas by-pass piping (between compressor discharge and evaporator coil) inside building – 25 mm (1") thick;
- .26 heat pump equipment earthloop piping – 25 mm (1") thick.
- .2 **Piping:** Ensure that the overlap flap of the sectional insulation jacket is secured tightly in place. Cover section to section butt joints with tape sealant.
- .3 **Fittings:** Insulate fittings with sectional pipe insulation mitred to fit tightly, and cover butt joints with tape sealant, or, alternatively, wrap fittings with blanket mineral fibre insulation to a thickness and insulating value equal to the sectional insulation, secure in place with adhesive and/or wire, and cover with PVC fitting covers.

- .4 **"Cold" Piping Unions, Valves, Strainers, Etc.:** Unless otherwise specified, insulate unions, valves, strainers, and similar piping system accessories in "cold" piping such as domestic water or chilled water piping with cut and tightly fitted segments of sectional pipe insulation with all joints covered with tape sealant, or, alternatively, wrap the piping union, valve, strainer, etc., with blanket mineral fibre and cover with PVC covers as for "Fittings" above.
- .5 **Flanges and Mechanical Couplings:** Terminate sectional insulation approximately 50 mm (2") from the flange or coupling on each side of the flange or coupling. Cover the flange or coupling with a minimum 50 mm (2") thickness of blanket mineral fibre insulation wide enough to butt tightly to the ends of the adjacent sectional insulation. Secure the blanket insulation in place and cover with a purpose made purpose made PVC coupling cover.
- .6 **Fire Protection Piping Drum Drips:** Drum drips in dry zone sprinkler and/or standpipe system piping will be traced with electric heating cable as part of the electrical work, and are generally not shown on the drawing(s). Confirm the number and size of the drum drips required with the trade providing the piping and include for the insulation to suit. Note that wherever possible drum drips will be located in heated areas.
- .7 **Concealed Rough-In Piping at Plumbing Fixtures:** Take special care at concealed water rough-in piping at plumbing fixtures to ensure that the piping is properly insulated. If necessary due to space limitations, use 12 mm (½") thick sectional pipe insulation in lieu of 25 mm (1") thick insulation.

3.04 PIPE INSULATION REQUIREMENTS – FLEXIBLE FOAM ELASTOMERIC

- .1 Install flexible elastomeric pipe insulation in strict accordance with the manufacturer's published instructions to suit the application, and using adhesive, joint sealants and finish to produce a water-tight installation. Insulate the following pipe with flexible elastomeric pipe insulation of the thickness indicated.
 - .1 refrigerant suction and hot gas piping outside the building – 25 mm (1") thick.

3.05 PIPE INSULATION REQUIREMENTS – FIRE RATED INSULATION

- .1 Where pipe (inside the building and above ground) which is to be insulated as specified above penetrates fire rated construction, provide fire-rated, non-combustible sectional insulation on the portion of pipe in the fire barrier and for a distance of 50 mm (2") on either side of the fire barrier. Insulation thickness is to be as specified, but in any case minimum 25 mm (1").

3.06 EQUIPMENT INSULATION REQUIREMENTS - SEMI-RIGID MINERAL FIBRE

- .1 Insulate the following equipment with semi-rigid mineral fibre board insulation of the thickness indicated:
 - .1 refrigeration machine water chiller(s) and suction elbow(s) – 50 mm (2") thick;
 - .2 uninsulated domestic hot water storage tank(s) – 40 mm (1½") thick;
 - .3 shell and tube type heat exchangers – 40 mm (1½") thick;
 - .4 chilled water or chilled glycol solution storage tank – 50 mm (2") thick;

- .5 heating main air separator – 40 mm (1½") thick;
- .6 chilled water expansion tank – 40 mm (1½") thick.
- .2 Install the insulation as required to fit the shape and contour of the equipment. Secure the insulation in place with adhesive, and with aluminum straps on 450 mm (18") centres. Apply a 6 mm (¼") thick skim coat of insulating cement, then, when the insulating cement has dried, apply a 6 mm (¼") thick coat of cement trowelled smooth.
- .3 Provide removable and replaceable insulated metal covers for all equipment with removable heads to permit the heads to be removed and replaced without damaging the adjacent insulation work.

3.07 EQUIPMENT INSULATION REQUIREMENTS – SEMI-RIGID MINERAL WOOL

- .1 Insulate the following equipment with calcium silicate equipment insulation of the thickness indicated:
 - .1 engine-generator set exhaust system silencer(s) – 75 mm (3") thick;
 - .2 uninsulated boiler breeching where inside the building – 75 mm (3") thick.
- .2 Cut or mitre the insulation (or use factory scored type insulation) to fit the shape and contour of the equipment and secure the insulation in place with aluminum straps on 450 mm (18") centres. Point all joints, mitres, scores and gaps with insulating cement. Apply a 12 mm (½") thick coat of insulating cement and trowel smooth.

3.08 DUCTWORK INSULATION REQUIREMENTS - MINERAL FIBRE

- .1 Insulate the following ductwork systems inside the building and above ground with mineral fibre insulation of the thickness indicated:
 - .1 all outside air intake ductwork, casings and plenums from fresh air intakes to and including mixing plenums or sections, or, if mixing plenums or sections are not provided, to the first heating coil, or if both mixing plenums or sections and heating coil sections are not provided, and the fresh air is not tempered, then the fresh air ductwork system complete – minimum 40 mm (1½") thick as required;
 - .2 mixed supply air or preheated supply air casings, plenums and sections to and including the fan section where not factory insulated – minimum 25 mm (1") thick rigid board or minimum 40 mm (1½") thick flexible blanket as required;
 - .3 supply air ductwork outward from fans, except for supply ductwork exposed in the area it serves – minimum 25 mm (1") thick rigid board or minimum 40 mm (1½") thick flexible blanket as required;
 - .4 exhaust discharge ductwork for a distance of 1.8 m (6') downstream (back) from exhaust openings to atmosphere, including any exhaust plenums within the 3 m (10') distance – minimum 25 mm (1") thick rigid board or minimum 40 mm (1½") thick flexible blanket as required;
 - .5 any other ductwork, casings, plenums or sections specified or detailed on the drawings to be insulated – thickness as specified.

- .2 Insulation for casings, plenums, and exposed rectangular ductwork is to be rigid board type. Insulation for round ductwork and concealed rectangular ductwork is to be blanket type.
- .3 **Exposed Rectangular Ducts and/or Casings:** Liberally apply adhesive to all surfaces of the duct and/or casing. Accurately and neatly press the insulation into the adhesive with tightly fitted butt joints. Provide pin and washer insulation fasteners at 300 mm (12") centres on bottom and side surfaces. Secure and seal all joints with 75 mm (3") wide tape sealant. Additional installation requirements are as follows:
 - .1 at trapeze hanger locations install insulation between the duct and the hanger;
 - .2 provide drywall type metal corner beads on edges of ductwork, casings and plenums in equipment rooms, service corridors, and any other area where the insulation is subject to accidental damage, and secure in place with tape sealant.
- .4 **Concealed Rectangular or Oval Ductwork:** Liberally apply adhesive to all surfaces of the duct, and wrap the insulation around the duct with a top butt joint and tight section to section butt joints. Provide pin and washer insulation fasteners at 300 mm (12") centres on bottom surfaces. Secure and seal all joints with 75 mm (3") tape sealant. Additional installation requirements are as follows:
 - .1 at each trapeze type duct hanger provide a 100 mm (4") wide full length piece of rigid mineral fibre board insulation between the duct and the hanger.
- .5 **Exposed & Concealed Round or Oval Ductwork:** Accurately cut sections of insulation to fit tightly and completely around the duct. Liberally apply adhesive to all surfaces of the duct, and wrap the insulation around the duct with a top butt joint and tight section to section butt joints. Seal all joints with tape sealant. At duct hanger locations install the insulation between the duct and hanger. At each hanger location for concealed ductwork where flexible blanket insulation is used, provide a 100 mm (4") wide full circumference strip of semi-rigid board type duct insulation between the duct and the hanger.
- .6 **Common Duct Insulation Requirements:** Insulation application requirements common to all types of rigid ductwork are as follows:
 - .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 canvas jacket material, patch all vapour barrier damage by means of tape sealant.

3.09 DUCTWORK INSULATION REQUIREMENTS - FLEXIBLE ELASTOMERIC

- .1 Insulate all exposed exterior ductwork (except fresh air intake ductwork) and associated plenums and/or casings outside the building with minimum 40 mm (1½") thick flexible elastomeric sheet insulation as required, applied in two minimum 20 mm (¾") thick layers with staggered tightly butted joints.
- .2 Install with adhesive in strict accordance with the manufacturer's published instructions to produce a weather-proof installation. Ensure that sheet metal work joints are sealed watertight prior to applying insulation.

3.10 DUCT WRAP REQUIREMENTS – FIRE RATED MATERIAL

- .1 Provide blanket type fire rated duct wrap system material for the following ductwork to produce the fire rating indicated:
 - .1 stairwell pressurization ductwork and relief ductwork from exterior louver to stairwell – 2 hour rating;
- .2 Install the duct wrap material in accordance with ULC design requirements and the wrap supplier's instructions.
- .3 Coordinate installation of duct wrap with the installation of the ductwork.
- .4 Arrange and pay for the duct wrap supplier to examine the completed duct wrap system at the site. Submit a letter from the supplier to certify that the duct wrap system has been properly installed.

3.11 APPLICATION OF INSULATING COATINGS

- .1 Apply, in accordance with the manufacturer's instruction, insulating coatings to the following bare metal surfaces:
 - .1 paint all bare metal surfaces clear of "cold" piping and/or equipment insulation for a distance of from 300 mm (12") to 600 mm (24") clear of the pipe or equipment insulation, with "No Sweat-FX" anti-condensation coating;
 - .2 paint all bare metal surfaces associated with mechanical systems with an operating temperature 60°C (140°F) with "ThermaLite" insulating coating.
- .2 Apply coatings with a brush. Remove any splatter or excess coating from adjacent surfaces.

3.12 INSULATION FINISH REQUIREMENTS

- .1 **Canvas:** Unless otherwise shown and/or specified, jacket all exposed mineral fibre insulation, and calcium silicate duct insulation work inside the building with canvas secured in place with a full 100% covering coat of lagging adhesive. Accurately cut canvas with scissors or a knife. Do not rip or tear canvas to size. Remove lagging adhesive splatter from adjacent uninsulated surfaces.

END OF SECTION

1 GENERAL

1.01 APPLICATION

- .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 Section and is to be read accordingly.

1.02 SUBMITTALS

- .1 **Name and Qualifications of Testing and Balancing Agency:** Within thirty 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 entitled Quality Assurance below.
- .2 **Draft Report:** Submit a draft report, as specified in Part 3 of this Section.
- .3 **Final Report:** Submit a final report, as specified in Part 3 of this Section.
- .4 **Warranty:** Submit a testing and balancing warranty as specified in Part 3 of this Section.

1.03 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 “submain” – 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.

1.04 QUALITY ASSURANCE

- .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. 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 three years, and is to be certified as an independent agency **in all required categories** by one of the following:
 - .1 AABC - Associated Air Balance Council;
 - .2 NEBB - National Environmental Balancing Bureau;
- .2 **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 one 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.

2 PRODUCTS

Not Applicable

3 EXECUTION

3.01 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 **Domestic Water Systems:** TAB of domestic water systems (all piping extended from the Municipal main) is to include:
 - .1 domestic hot water recirculation piping;
 - .2 tempered water piping flows.
 - .2 **Heating Systems:** TAB of heating systems is to include all piping and equipment fluid temperatures, flows and control, and if TAB is not done during the heating season, a follow-up site visit during the heating season will be required to confirm proper flows and temperatures, and any required system "fine tuning".
 - .3 **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".
 - .4 **Air Handling Systems:** TAB of air handling systems is to include all equipment and ductwork air temperatures, capacities and flows.

3.02 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, adjusted, and then successfully performance tested.
- .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 plus or minus 5 percent 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 plus or minus 5% of design values, and make and record measurements which are within plus or minus 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 AABC 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 two complete sets of draft reports. Only one 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, three-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 Air Systems;
 - .3 Hydronic Systems;
 - .4 Temperature Control Systems;
 - .5 Special 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, 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 AABC 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 AABC 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 one full heating season and one 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.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

- .1 **Shop Drawings/Product Data:** Submit shop drawings/product data sheets for all products specified in Part 2 of this Section. Include pump motor product data sheets and pump performance curves.
- .2 **Letter of Certification:** Submit a copy of a letter from the domestic cold water booster pump set supplier certifying proper installation, and a copy of the pump supplier's start-up report, all as specified in Part 3 of this Section.

2 PRODUCTS

2.01 DOMESTIC COLD WATER PRESSURE BOOSTER PUMP SET

- .1 Packaged type, multi-pump pressure booster set as per the drawing schedule, completely factory assembled and pre-piped on a primed and painted steel baseplate with primed and painted structural steel framework, with rubber mounts to isolate pipework from the baseplate assembly, and a pre-wired power and control panel, all factory tested, and calibrated, and ready for suction and discharge piping connections and electrical power connections.
- .2 **Pumps:** Each pump is to be a bronze fitted, centrifugal, single suction in-line pump complete with a cast iron volute and motor/pump bracket, a dynamically balanced closed type cast bronze impeller secured to a stainless steel shaft, a motor as per the mechanical work Section entitled Basic Mechanical Materials and Methods, a water-tight mechanical seal serviceable without breaking pipe connections, and the following:
 - .1 common suction and discharge headers with isolating valves and non-slam check valves for each pump, all minimum 1725 kPa (250 psi) rated;
 - .2 a pressure reducing valve for each pump, with by-pass on discharge;
 - .3 a thermal bleed circuit with aquastat and solenoid valve.
- .3 **Control Panel:** The control panel is to consist of an EEMAC 2 primed and painted steel enclosure complete with hinged (full length piano hinge) door with catch and padlocking facilities, wiring diagram on the back side of the door, and:
 - .1 a main door, interlock disconnect switch with a fused circuit for each motor;
 - .2 a fully protected, full voltage, non-reversing across-the-line magnetic starter for each motor;
 - .3 a current sensing device;
 - .4 a HOA selector switch for each pump to permit manual or automatic pump operation;
 - .5 a control section with 115 volt fused secondary control circuit transformer, adjustable pressure switches, and minimum run time delay;
 - .6 identified suction and discharge pressure gauges conforming to requirements specified in the mechanical work Section entitled Basic Mechanical Materials and Methods;

- .7 low limit pressure switch with low suction pressure alarm LED, arranged to shut-off the pump(s) should the pressure in the water service main fall to a dangerously low level, with auxiliary contact to connect to a central control and monitoring system;
- .8 a high pressure cut-out switch with alarm LED and auxiliary contact;
- .9 a power "ON" indicating light;
- .10 manual alternation of the lead pump.
- .4 Pump controls are to be factory pre-set to suit job conditions, are to sequence the pumps to deliver constant pressure domestic cold water, and are to operate as follows:
 - .1 the lead pump is to operate continuously;
 - .2 when system demand exceeds the capacity of the lead pump, the second pump is to automatically start in parallel, and run for a minimum period of time to prevent the pump from cycling on and off;
 - .3 should the lead pump fail for any reason, the second pump is to start automatically and run continuously.
- .5 **Acceptable Manufacturers:** Acceptable manufacturers are:
 - .1 S.A. Armstrong Ltd.;
 - .2 ITT Fluid Products Bell & Gossett;
 - .3 Pentair Pump Group "Aurora".

3 EXECUTION

3.01 INSTALLATION OF DOMESTIC COLD WATER PRESSURE BOOSTER PUMP SET

- .1 Provide a package type domestic cold water pressure booster pump set where shown.
- .2 Mount the assembly on vibration isolation on a concrete housekeeping pad, shim the unit level such that suction and discharge headers are vertical, and secure in place.
- .3 Provide flexible connections to suction and discharge headers and support suction and discharge piping independent of the pump set assembly. Pipe the thermal bleed to drain.
- .4 **Equipment and System Start-Up:** Refer to requirements of the article entitled Equipment and System Start-Up in the mechanical work Section entitled Mechanical Work General Instructions.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

- .1 **Shop Drawings/Product Data:** Submit shop drawings/product data sheets for all products specified in Part 2 of this Section except for pipe and fittings, and chlorine.

2 PRODUCTS

2.01 PIPE, FITTINGS AND JOINTS

- .1 **PVC:** ULC listed, rigid, Class 150, DR18, 1035 kPa (150 psi) pressure rated bell and spigot pattern PVC pipe to CAN/CSA-B137.3, and CSA certified fittings to CAN/CSA B137.2, and AWWA C900, complete with gasket joints, and Ford "Uni-Flange" or equal restraint collars as per Part 3 of this Section.
- .2 **Soft Copper:** Type "K" soft copper to ASTM B88, supplied in a continuous coil with no joints if possible, and complete with, if joints are required, compression type flared joint couplings.
- .3 **Stainless Steel:** Schedule 10S type 304 stainless steel, ASTM A312, factory or site roll grooved, complete with Victaulic or equal type 304 stainless steel roll grooved end fittings and, unless otherwise specified, Victaulic Style 489 or equal lightweight rigid type 304L stainless steel couplings and coupling gaskets equal to Victaulic Grade E or Grade M.
- .4 **Hard Copper - Solder Joint:** Type "L" hard drawn seamless copper to ASTM B88, complete with copper solder type fittings to ASME/ANSI B16.18 and soldered joints using The Canada Metal Co. Ltd. "SILVABRITE 100" or equal lead-free solder for cold water pipe, and 95% tin/5% Antimony or "SILVABRITE 100" solder for other services.
- .5 Grooved joint couplings and fittings may be used in lieu of soldered joints provided the system is manufactured to copper-tubing sizes. (Flaring tube or fitting ends to accommodate alternate sized couplings is not permitted.).
- .1 Fittings shall be cast bronze to ASME B16.18 or wrought copper to ASME B16.22.
Standard of Acceptance: Victaulic Copper-Connection.
- .2 Couplings shall consist of two ductile iron housings cast with offsetting angle-pattern bolt pads, pressure responsive elastomer gasket approved for potable water services, and zinc-electroplated steel bolts and nuts. Installation-Ready, for direct stab installation without field disassembly. Basis of Design: Victaulic Series 607H.
- .6 **Copper Pressure Coupled Joint:** Type "L" hard drawn seamless copper to ASTM B88 with "ProPress with Smart Connect feature" copper fittings with EDPM seals, and pressure type crimped joints made by use of a Rigid Tool Co. Model RP 330 or Model RP 210 electro-hydraulic crimping tool.
- .7 **Semi-Rigid Polyethylene Tubing:** Versa Fittings and Mfg. Inc. 12 mm (½") dia., high density, semi-rigid polyethylene tubing, 1380 kPa (200 psi) rated.
- .8 **PEX Tubing:** Non-barrier type cross-linked polyethylene piping in accordance with CAN/CSA-B137.5, ASTM F876 and tested for compliance by an independent third-party agency. The piping is to be complete with brass inserts and crimp-ring joint fittings and couplings.

2.02 SHUT-OFF VALVES

- .1 **Ball Valves:** Class 600, 4140 kPa (600 psi) WOG rated full port ball type valves, each complete with a forged brass body with solder ends, forged brass cap, and blowout-proof stem, solid forged brass chrome plated ball, "Teflon" or "PTFE" seat, and a removable lever handle. Valves in insulated piping are to be complete with stem extensions. Acceptable products are:
 - .1 Toyo Valve Co. Fig. 5049A;
 - .2 Kitz Corporation Code 59;
 - .3 Victaulic Series 726.
- .2 **Butterfly Valves - Flanged Joint:** Non-corrosive, minimum 2065 kPa (300 psi) cold water pressure rated, resilient seated butterfly valves, each complete with a coated cast ductile iron lug type body, stainless steel shaft, bronze disc, and EPDM seat, and each suitable for domestic water bubble-tight dead end service with the valve in position and either side of the connecting piping removed. Butterfly valves to and including 100 mm (4") dia. are to be equipped with lever handles. Butterfly valves larger than 100 mm (4") dia. are to be equipped with worm gear operators. Acceptable products are:
 - .1 Kitz Corporation Code #6122EL/EG;
 - .2 Toyo Valve Co. #918BESL/EG;
 - .3 Victaulic Series 608.

2.03 CHECK VALVES

- .1 **Horizontal:** Class 125, bronze, 1380 kPa (200 psi) WOG rated horizontal swing type check valves with solder ends. Acceptable products are:
 - .1 Toyo Valve Co. Fig. 237;
 - .2 Kitz Corporation Code 23;
 - .3 Apollo Valves # 61-600.
- .2 **Vertical:** Equal to Kitz Corp. Code 26, bronze, 1725 kPa (250 psi) WOG rated vertical lift check valve with soldering ends.

2.04 DRAIN VALVES

- .1 Minimum 2070 kPa (300 psi) water rated, 20 mm ($\frac{3}{4}$ ") dia., straight pattern full port bronze ball valves, each complete with a threaded outlet suitable for coupling connection of 20 mm ($\frac{3}{4}$ ") dia. garden hose, and a cap and chain. Acceptable products are:
 - .1 Toyo Valve Co. Fig. 5046;
 - .2 Kitz Corporation Code 58CC;
 - .3 Watts Industries (Canada) Inc. #B6000-CC.

2.05 DOMESTIC HOT WATER PIPING BALANCING VALVES (RECIRCULATION PIPING)

- .1 Solder or flanged end type as required, globe style, non-ferrous circuit balancing valves designed to facilitate precise flow measurement, precision flow balancing, and positive shut-off, complete with capped and valved drain connection, and valved ports for connection to a differential pressure meter. Acceptable products are:

- .1 S.A. Armstrong Model CBV Series;
- .2 Tour and Andersson Model TBV Series;
- .3 Watts Industries (Canada) Inc. Model CSM Series.

2.06 PRESSURE REDUCING VALVES

- .1 For piping to and including 50 mm (2") diameter, non-corrosive, non-ferrous direct spring acting pressure reducing valves to CAN/CSA B356, each factory set at 345 kPa (50 psi) unless otherwise specified or required, each field adjustable from 175 kPa (25 psi) to 620 kPa (90 psi) and each complete with an integral inlet strainer. Acceptable products are:
 - .1 Conbraco 36C Series;
 - .2 Zurn/Wilkins 600 Series;
 - .3 Watts Industries (Canada) Inc. #25AUB Series;
- .2 For piping 65 mm (2½") diameter and larger, non-corrosive pilot operated pressure reducing valve to CAN/CSA B356, factory set at the required pressure, field adjustable, and complete with a bronze body and trim, screwed or flanged connections, and brass body pilot valve with stainless steel seat. Each factory set at 345 kPa (50 psi) unless otherwise specified or required, each field adjustable from 175 kPa (25 psi) to 620 kPa (90 psi) and each complete with an integral inlet strainer. Acceptable products are:
 - .1 Singer Valve Model 106 PR;
 - .2 Zurn/Wilkins Model ZW109;
 - .3 Watts Industries (Canada) Inc. Series N223.

2.07 DOMESTIC HOT WATER THERMOSTATIC MIXING VALVES

- .1 Lawler Manufacturing Co. Inc. 800 Series "High-Low Thermostatic Mixer" factory assembled rough bronze thermostatic mixing valve assembly complete with rotatable union end inlet piping with check stops and stainless steel strainer screens, union outlet piping with thermometer connection, all sized as shown, and the following:
 - .1 a mixing valve with liquid motor, stainless steel piston and liner, tamper-resistant control adjustment, and three-way protection against runaway temperatures, thermal shock, and scalding;
 - .2 a dial type thermometer conforming to requirement specified in the mechanical work Section entitled Basic Mechanical Materials and Methods;
 - .3 a ball type outlet shut-off valve conforming to valve requirements specified in this Section;
- .2 Acceptable manufacturers are:
 - .1 Lawler Manufacturing Co. Inc.;
 - .2 Leonard Valve Co.;
 - .3 Symmons Industries Inc.

2.08 CHLORINE

- .1 Sodium hypochlorite to AWWA B-300-75.

3 EXECUTION

3.01 PIPING INSTALLATION REQUIREMENTS

- .1 All piping installation shall be in compliance with latest Ontario Building Code.
- .2 Provide all required domestic water piping for all plumbing fixtures.
- .3 Piping, unless otherwise specified, is to be as follows:
 - .1 for underground piping 100 mm (4") dia. and larger outside and/or inside the building - rigid PVC;
 - .2 for underground piping less than 100 mm (4") dia. inside building - Type "K" soft copper;
 - .3 for 12 mm (½") dia. trap seal primer tubing located underground or in concrete or masonry construction - semi-rigid polyethylene;
 - .4 for branch hot and cold piping above ground from mains and risers to fixtures, fittings, and equipment where fire rated construction is not penetrated, and at your option, PEX tubing installed and joined in strict accordance with the manufacturer's printed instructions.
 - .5 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.
- .4 Slope all piping so that it can be completely drained.
- .5 Provide proper dielectric unions in all connections between copper pipe and ferrous pipe or equipment. Dielectric unions are to conform to ASTM F1545-97 and are to be complete with a thermoplastic liner.
- .6 Provide water supply for all irrigation control valves on site and terraces where indicated on the landscape drawings.
- .7 Provide water supply for all hose bibbs and non-freeze water hydrants where indicated on the mechanical and landscape drawings.

3.02 INSTALLATION OF SHUT-OFF AND CHECK VALVES

- .1 Refer to Part 3 of the mechanical work Section entitled Basic Mechanical Materials and Methods.
- .2 Provide shut-off valves on all branches leading to plumbing fixtures and mechanical equipment on all floors. Valves shall be gate type located behind access doors, under vanity, installed close together for access through one 200mm x 200mm (8" x 8") access door.

3.03 INSTALLATION OF DRAIN VALVES

- .1 Provide a drain cock and drain valve at each bottom of domestic water piping risers, at all other piping low points, and wherever else shown.
- .2 Provide a drain cock and drain valve at each bottom of fan coil or heat pump water piping risers.
- .3 Provide a drain valve at each connection to the irrigation loops for winter drain-off.
- .4 Provide a drain valve at the bottom of the outdoor chiller.

- .5 Locate drain valves so that they are easily accessible

3.04 INSTALLATION OF DOMESTIC HOT WATER PIPING BALANCING VALVES

- .1 Provide balancing valve in each domestic hot water recirculation branch from domestic hot water riser.
- .2 Group the valves such that it is easily accessible.

3.05 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 preset to required pressures.
- .2 Check and test operation and adjust as required.

3.06 INSTALLATION OF DOMESTIC HOT WATER MIXING VALVES

- .1 Provide a domestic hot water thermostatic mixing valve assembly where shown and wall mount.
- .2 Adjust each valve to design requirements and check and test operation. Set maximum temperature limit stops.
- .3 Identify each valve and its water temperature delivery setting with an engraved nameplate.

3.07 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 flushing is complete, disinfect the piping with a solution of chlorine in accordance with AWWA C601.
- .5 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

1.01 SUBMITTALS

- .1 **Shop Drawings/Product Data:** Submit shop drawings/product data sheets for all products specified in Part 2 of this Section.

2 PRODUCTS

2.01 INTERIOR HOSE BIBBS

- .1 **Surface - Exposed – Cold Water -Unfinished Areas:** Brass or bronze hose bibb with hose end vacuum breaker. Acceptable products are:

- .1 Watts Industries (Canada) Inc. #SC8-1;
- .2 Zurn/Wilkins # Z1341 with hose end vacuum breaker;
- .3 Jay R. Smith #5609QT-SAP.

- .2 **Exposed – Unfinished Areas – Hot and Cold Water:** Mixing faucet for surface mounting. Acceptable products are:

- .1 Delta Commercial #28T8083;
- .2 Zurn #Z841L1-RC;
- .3 Jay R. Smith #5560QT-LB-SAP.

2.02 EXTERIOR NON-FREEZE WALL HYDRANTS

- .1 **Flush-Concealed:** Recessed, encased, self-draining hydrants, each complete with a copper casing, operating rod assembly to suit the wall thickness, polished nickel bronze box with hinged locking cover, 20 mm (¾") dia. threaded hose connection outlet, vacuum breaker, and a loose tee handle operating key. Acceptable products are:

- .1 Jay R. Smith #5519-98;
- .2 Zurn #Z1320;
- .3 Mifab #MHY-26.

2.03 FLOOR DRAIN TRAP SEAL PRIMERS

- .1 **Primer Valve Type with Manifold:** Precision Plumbing Products Inc. Model P1-500 trap primer valve constructed as specified above for the Model P2-500 primer valve, complete with a Model DU-3 or DU-4, 3 or 4 outlet distribution unit for priming 3 or 4 traps, and at Model "YS-8" supply tube with combinations of Model DU-3 and DU-4 distribution units for priming from 5 to 6 traps.

- .2 **Electronic Type:** Precision Plumbing Products #PT Series surface wall mounting, CSA certified, 115 volt, 1 phase, 60 Hz., electronic, automatic trap priming manifolds, each sized to suit the number of drain traps or interceptors serviced, and each complete with:

- .1 a galvanized steel cabinet with door;
- .2 20 mm (¾") dia. NPT copper pipe inlet with shut-off valve and water hammer arrestor;

- .3 a solenoid valve, an atmospheric vacuum breaker, and a discharge manifold with 12 mm (½") dia. compression type copper tube connections on 40 mm (1½") centres with quantity to suit the number of items to be primed;
- .4 a control panel with circuit breaker, 5 ampere fuse, 24 hour timer, and manual override toggle switch.

2.04 SHOCK ABSORBERS

- .1 Type 304 stainless steel piping shock absorbers, each complete with a nesting type bellows and a casing of sufficient displacement volume to dissipate the kinetic energy generated in the piping system, and each sized to suit the connecting potable water pipe and equipment it is provided for. Acceptable products are:
 - .1 Jay R. Smith 5000 Series "HYDROTROL";
 - .2 Zurn #Z1700 "SHOKTROL";
 - .3 Mifab "HAMMERGUARD" WHB Series.

2.05 BACKFLOW PREVENTERS (REDUCED PRESSURE ZONE ASSEMBLY)

- .1 Lead-free reduced pressure zone assembly backflow preventer in accordance with CAN/CSA B64 (including supplements), each of bronze or epoxy coated cast iron bronze fitted construction depending on size, and complete with inlet strainer, inlet and outlet shut-off valves, an intermediate relief valve, ball valve type test cocks, and a proper air gap fitting. Acceptable products are:
 - .1 Watts Industries #LF009QT-S for 12 mm (½") size, #LF909QT-S for 20 mm to 50 mm (¾" to 2") size, and #LF909-NRS-S for 65 mm (2½") and larger size;
 - .2 Zurn/Wilkins 975XL2 and 375 Series;
 - .3 "Apollo" Valves manufactured by Conbraco Industries Inc. Series 4ALF;

2.06 AIR VENTS

- .1 Equal to ITT Hoffman Specialty No. 78 cast brass, 1035 kPa (150 psi) rated, 20 mm (¾") straight water main vent valves, each tapped at the top for a 3.2 mm (1/8") safety drain connection.

2.07 DOMESTIC WATER THERMAL EXPANSION TANK

- .1 Pre-charged domestic water thermal expansion tank in accordance with Section VIII of the ASME Boiler and Pressure Code, carbon steel outer shell construction and complete with fixed butyl rubber bladder to prevent water from contacting shell interior, top NPT stainless steel system connection, 0.301"-32 charging valve connection and prime painted exterior. Acceptable products are:
 - .1 Watts Industries (Canada) Inc. Series DETA;
 - .2 Zurn/Wilkins Model WTTA.

2.08 ELECTRIC SIDE ARM HEATER

- .1 340 stainless steel pipe body. CCI Thermal Technologies, model EXST8399, 18KW or 12KW as specified on drawings. 600V/3ph/60hz.

3 EXECUTION

3.01 INSTALLATION OF HOSE BIBBS

- .1 Provide hose bibbs where shown and/or specified on the drawings.
- .2 Unless otherwise shown, specified, or required, mount hose bibbs approximately 1 m (3') above the floor. Confirm exact locations prior to roughing-in.
- .3 Provide a 20mm domestic cold water line from building low pressure water main and completed with shut-off valve inside the building to each hose bibb.

3.02 INSTALLATION OF EXTERIOR NON-FREEZE WALL HYDRANTS

- .1 Provide non-freeze wall hydrants where shown.
- .2 Install hydrants level and plumb such that hose outlets are approximately 600 mm (2') above grade level. Confirm exact locations prior to roughing-in.
- .3 Provide a 20mm domestic cold water line from building low pressure water main and completed with shut-off valve inside the building to each exterior non-freeze wall hydrant.

3.03 INSTALLATION OF TRAP SEAL PRIMERS

- .1 Provide all required accessible trap seal primers to automatically maintain a water seal in floor drain traps, whether shown on the drawings or not.
- .2 **Packaged Electronic Trap Primers:** Provide 115 volt, electronic, surface wall mounting trap primer assemblies for multiple (4 to 30) traps. Include for a 115 volt 15 ampere panel breaker and wiring in conduit from the closest panelboards to the primer assembly, all to the wiring standards of the electrical. Adjust primer water flow and timing to suit the number of traps served.
- .3 Ensure that trap primer piping is secured to floor drain primer tappings and not terminated through the tapping in the throat of the drain.

3.04 INSTALLATION OF SHOCK ABSORBERS

- .1 Provide accessible shock absorbers in domestic water piping where shown, specified, or detailed on the drawings.
- .2 Ensure that the size of each shock absorber is properly selected to suit the size of the domestic water pipe and the equipment the pipe is connected to.

3.05 INSTALLATION OF BACKFLOW PREVENTERS (REDUCED PRESSURE ZONE ASSEMBLY)

- .1 Provide a reduced pressure zone assembly backflow preventer on incoming DCW incoming service and in each direct domestic water connection to equipment and irrigation system other than plumbing fixtures and fittings.
- .2 Locate each backflow preventer on floor or wall between 765 mm and maximum 1.5 m (30" and 60") above the floor such that it is easily accessible for maintenance and testing. Equip each backflow preventer with an air gap fitting and pipe the reduced pressure zone water outlet to drain.

- .3 Test operation of each backflow preventer in accordance with requirements of CAN/CSA B64 by personnel certified for such testing by governing authorities, and submit signed test results and a properly and clearly identified and marked inspection and test record card for each backflow preventer.

3.06 INSTALLATION OF AIR VENTS

- .1 Provide accessible air vents in domestic water piping where shown to prevent air binding.
- .2 Extend copper indirect drain piping from the top drain connection of each vent to the nearest suitable drain.
- .3 Locate exact vent locations on as-built record drawings.

3.07 INSTALLATION OF DOMESTIC WATER THERMAL EXPANSION TANK

- .1 Provide one 50 gallon water thermal expansion tank in domestic cold water piping in the mechanical penthouse and where shown on the drawings.
- .2 Provide one 100 gallon water thermal expansion tank in domestic hot water piping in the mechanical penthouse and where shown on the drawings.
- .3 Unless otherwise specified, mount the hot water expansion tank at least 450 mm (18") from the cold water inlet to domestic water storage tank.
- .4 Adjust pre-charge to match incoming water pressure after installation.
- .5 Install in accordance with the manufacturer's instructions and as per local governing Codes and Regulations.

3.08 INSTALLATION OF SIDE ARM HEATER

- .1 Provide electric side arm heaters where shown and/or specified on the drawings.
- .2 Provide one strainer on the inlet of each side arm heater.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

- .1 **Shop Drawings/Product Data:** Submit shop drawings/product data sheets for all products specified in this Section except pipe and fittings.

2 PRODUCTS

2.01 PIPE, FITTINGS AND JOINTS

- .1 **PVC Sewer:** DR35 rigid, green PVC hub and spigot pattern sewer pipe and fittings to CAN/CSA B182.2, with gasket joints assembled with pipe lubricant.
- .2 **PVC - DWV:** Equal to Ipex System XRF 15-50 rigid 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.
- .3 **Copper- Solder Joint:** Type DWV hard temper to ASTM B306, with forged copper solder type drainage fittings and 50% lead - 50% tin solder joints.
- .4 Grooved joint couplings and fittings may be used in lieu of soldered joints provided the system is manufactured to copper-tubing sizes. (Flaring tube or fitting ends to accommodate alternate sized couplings is not permitted.).
 - .1 Fittings shall be cast bronze to ASME B16.18 or wrought copper to ASME B16.22. Standard of Acceptance: Victaulic Copper-Connection.
 - .2 Couplings shall consist of two ductile iron housings cast with offsetting angle-pattern bolt pads, pressure responsive elastomer gasket approved for potable water services, and zinc-electroplated steel bolts and nuts. Installation-Ready, for direct stab installation without field disassembly. Basis of Design: Victaulic Series 607H.
- .5 **Cast Iron:** Class 4000 cast iron pipe, fittings, and mechanical coupling joints to CAN/CSA B70.
- .6 **PVC Weeper Piping:** 100 mm (4") dia. corrugated perforated PVC pipe with an integral geotextile filter fabric sheets (60 microns f.o.s),

2.02 SHUT-OFF AND CHECK VALVES

- .1 **Shut-off Valves:** Class 600, 4140 kPa (600 psi) WOG rated full port ball valves, each complete with a forged brass body, blowout-proof stem, chrome plated solid brass ball, solder or screwed ends as required, and removable lever handle. Acceptable products are:
 - .1 Toyo Valve Co. Fig. 5049A or Fig. 5044A;
 - .2 Kitz Corporation Code 58 or Code 59;
 - .3 Victaulic Co. of Canada Ltd. Series 722;
 - .4 Watts Industries (Canada) Inc. #FBV-3 or #FBVS-3.
- .2 **Check Valves:** Class 125, bronze, 1725 kPa (250 psi) WOG rated vertical lift check valve with solder or screwed ends as required, and, for horizontal piping, Class 125, bronze 1380 kPa (200 psi) WOG rated swing check valves with solder or screwed ends as follows:

- .1 Toyo Valve Co. Fig. 231 or Fig. 236 or Fig. 237;
- .2 Milwaukee Valve Co. #1510 or #510;
- .3 Kitz Corporation Code 36 or Code 22 or Code 23.

3 EXECUTION

3.01 DRAIN AND VENT PIPING INSTALLATION REQUIREMENTS

- .1 Drain and vent piping installation shall be in compliance with latest Ontario Building Code.
- .2 Provide all required drainage and vent piping. Pipe, unless otherwise specified, is to be as follows:
 - .1 for underground pipe inside the building and to points 1.5 m (5') outside the building lines - rigid PVC sewer pipe, minimum 75 mm (3") diameter;
 - .2 for pipe inside the building and above ground in sizes to and including 65 mm (2½") diameter - type DWV copper;
 - .3 for pipe inside the building and above ground in sizes 75 mm (3") diameter and larger - cast iron;
 - .4 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 - rigid PVC DWV, the piping material shall be approved by the owner and consultant during tendering stage;
 - .5 for drainage pump discharge pipe connections from the pump to and including shut-off and check valve connections - Type "DWV" copper with Victaulic® Copper Connection® fittings and couplings
 - .6 All storm drainage piping joints in finished areas and garage shall be cast iron with MJ couplings with double clamps and bracing.
- .3 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').
- .4 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.
- .5 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').
- .6 All drain and soil piping turns shall be made with long radius bends or 1/8 bends and fittings and 45 degree elbows.
- .7 Provide pipe joint bracing at each bottom of the sanitary stacks and rain water leaders. Refer to drawing detail for the installation.
- .8 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.
- .9 Provide proper dielectric unions at connections between copper pipe and ferrous pipe or

equipment.

- .10 Rigid PVC DWV piping shall not be installed in ceiling plenum.
- .11 Rigid PVC DWV piping shall not penetrate any fire rated construction unless the fire stopping details are approved by city and consultant.

3.02 INSTALLATION OF BUILDING WEEPER SYSTEM PIPING

- .1 Provide all required building foundation weeper piping and to extend to a concrete sand settling sump as shown and detailed on the drawings. Weeper piping is to be perforated PVC with an integral sock.
- .2 Provide all required sand settling sump piping, and connect the sump discharge to a storm main terminated 1.5 m (5') outside the building.
- .3 the pipes shall be placed parallel to each other with a spacing in the range of 2500mm (typical to all) unless specified on the drawings.

3.03 INSTALLATION OF SHUT-OFF AND CHECK VALVES

- .1 Provide a shut-off valve and a check valve in the discharge piping of each drainage pump.
- .2 Locate valves so that they are easily accessible without the use of ladders or other such devices.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

- .1 **Shop Drawings/Product Data:** Submit shop drawings/product data sheets for all products specified in this Section.

2 PRODUCTS

2.01 VENT STACK COVERS

- .1 Equal to Lexcor Model VSC-S "Flash-Tite" seamless, spun aluminum, insulated 330 mm (13") high vent stack covers with caps and a factory applied asphalt primer coating on the top and bottom of the flange.

2.02 CLEANOUTS

- .1 **Horizontal Piping:** TY pipe fitting with an extra heavy brass plug screwed into the fitting.
- .2 **Vertical Piping:** Bronze or copper cleanout tees in copper piping, each complete with a bronze ferrule, and, for cast iron piping, "BARRETT" type cast iron cleanout tees, each gas and water-tight and complete with a bolted cover.

2.03 FLOOR CLEANOUT TERMINATIONS

- .1 Factory finished cast iron terminations, each adjustable and complete with a cast iron body with neoprene sleeve, solid, gasketed, polished nickel-bronze scoriated top access cover to suit the floor finish, a seal plug, and captive, vandal-proof, stainless steel securing hardware. Provide heavy duty round top for the cleanout in parking garage, heavy traffic area and all service rooms. Acceptable products are:
 - .1 Zurn # ZN-1602-SP Series;
 - .2 Jay R. Smith #4020-F-C Series;
 - .3 Watts Industries (Canada) Ltd. # CO-200-R-1, CO-200-RX.
- .2 All cleanout terminations in areas with a tile or sheet vinyl floor finish are to be as above but with a square top in lieu of a round top.

2.04 FLOOR DRAINS

.1 RD ROOF DRAINS - STANDARD FLOW

- .1 All epoxy coated cast body, with deck clamp, adjustable combined extension and bearing pan, waterproofing flange, secured aluminium dome. Acceptable products are:

- .1 Zurn #Z-121-EBCR-AD;
- .2 Watts Industries (Canada) Ltd. RD-100-85.

.2 FCRD ROOF DRAINS - FLOW CONTROL

- .1 Flow Control Roof Drain, all epoxy coated cast body, with deck clamp, adjustable combined extension and bearing pan, waterproofing flange, 8 ½" (212mm) aluminium integral dome and flow control weir.

- .1 Zurn # SCF-121-EBCR-AD;
- .2 Watts Industries (Canada) Ltd. RD-100-85 with Accutrol Flow Restrictor.
- .3 FD FLOOR DRAINS - FINISHED AREAS
 - .1 All epoxy coated cast body, reversible flashing clamp with primary and secondary weepholes, trap primer connection with plug, nickel bronze 5" (127 mm) diameter strainer, secured with S.S. screws, 4" (100mm) throat on strainer.
 - .1 Zurn # ZN-415-B with Type B strainer
 - .2 Watts Industries (Canada) Ltd. PD-100-C-7-A5-1
- .4 FD FLOOR DRAINS - IN QUARRY OR MOSAIC TILED AREAS
 - .1 All epoxy coated cast body, reversible flashing clamp with primary and secondary weepholes, trap primer connection with plug, polished nickel bronze 5"x5" (127mm x 127 mm) strainer, secured with S.S. screws, 4" (100mm) throat on strainer.
 - .1 Zurn # ZN-415-Y with Type Y strainer
 - .2 Watts Industries (Canada) Ltd. PD-100-C-7-L5-1
- .5 FD FLOOR DRAINS - MECHANICAL ROOMS & UNFINISHED AREAS
 - .1 All epoxy coated cast body, 8" (203mm) diameter heavy-duty, seepage pan and combination membrane flashing clamp, trap primer connection with plug, sediment bucket, heavy duty cast iron or ductile iron grate.
 - .1 Zurn # ZN-556-Y adjustable heavy duty
 - .2 Watts Industries (Canada) Ltd. FD-320-7-5-4
- .6 FD FLOOR DRAINS –BOTTOM OF CONCRETE AIR SHAFT & TRENCH
 - .1 All epoxy coated cast iron body, 9-1/4" (235mm) diameter, flashing clamp and integral gravel stop, with self-locking ductile iron low profile dome. No hub outlet.
 - .1 Zurn # Z125
 - .2 Watts Industries (Canada) Ltd. FD-200-K
- .7 FD FLOOR DRAINS –FLOATING FLOOR
 - .1 All epoxy coated cast iron body, upper and lower bodies with serrated camping flanges with integral double weepholes, membrane clamp, neoprene expansion compensator and 8" round adjustable top, heavy duct ductile iron grate.
 - .1 Watts Industries (Canada) Ltd. FD-620
- .8 FFD FLOOR DRAINS WITH COMBINATION FUNNEL
 - .1 All epoxy coated cast body, 8" (203mm) diameter heavy-duty, seepage pan and combination membrane flashing clamp, trap primer connection with plug, sediment bucket, heavy duty cast iron or ductile iron grate with open throat cast iron funnel .
 - .1 Zurn # ZN-556-FO adjustable heavy duty

- .2 Watts Industries (Canada) Ltd. FD-320-EG
- .9 SD SCUPPER PIT DRAINS
 - .1 All epoxy coated cast body, secured angled drainage grate, flashing clamp and convertible 45 degree or 90 degree outlets. 4" (102mm) piping size,
 - .2 For elevator pits use Backwater Valve with extension, in line from floor drain immediately external to room. Provide access pit and cover for backwater valve if invert greater than 18" (457mm) from finished floor.
 - .1 Zurn # Z-187 adjustable heavy duty
 - .2 Watts Industries (Canada) Ltd. FD-320-EG C/W BV230
- .10 AD AREA DRAINS, INTERIOR PARKING AREAS
 - .1 All epoxy coated cast iron body, seepage flange, clamping devise and 12" x 12" (300mm x 300mm) heavy duty grate with S.S. hinge, vandal proff screws, sump receiver and sediment bucket. Provide side outlet "SO" when required for maximum headroom or to meet invert of main drain. For durable parking structure, drain to conform to CSA Std. S413M, provide Series 1.78BTE Drain with double drainage anti-ponding slots and top membrane clamp - all of non-rusting material.
 - .1 Zurn # Z-610-H-ADJ,
 - .2 Watts Industries (Canada) Ltd. FD-490-F-4
- .11 AD AREA DRAINS, ELEVATED PARKING AREAS (LARGE CAPACITY)
 - .1 All epoxy coated cast iron body with anchor flange, weepholes, 12"x12" (305mmx305mm) adjustable top with heavy duty ductile iron grate.no hub outlet.
 - .1 Zurn # Z-610-H-ADJ
 - .2 Watts Industries (Canada) Ltd. FD-460-F
- .12 SAD SODDED OR PLANTED AREA DRAINS
 - .1 All epoxy coated cast body, seepage flange, flashing clamping device, brearing pan, waterproofing and aluminium secured dome covered with stainless steel mesh. For access and surface water drainage provide with extensions to suit depth of bury and 8" (200mm) diameter grate. See mechanical drawings for detail.
 - .1 Zurn #ZA-130-AD-DC-R Planter Drain,
 - .2 Watts Industries (Canada) Ltd. FD-860-PA
- .13 PDD POOL DECK DRAINS
 - .1 PVC body with reversible clamp device and adjustable 6 1/2" (165mm) square polished nickel bronze secured strainer.
 - .2 Zurn #ZPVC-401-H Floor drain,

2.05 DRAINAGE TRENCH FRAMES AND GRATING

- .1 Welded, hot dipped galvanized, 45 mm x 45 mm x 6.4 mm (1¾" x 1¾" x ¼") carbon steel angle frame, 300 mm (12") wide, with anchor straps and lengths as required, and baked epoxy coated cast iron slotted grating in 600 mm (24") long sections. Contractor shall verify and coordinate the sizes of the trench on site prior to submitting the shop drawings. Acceptable products are:

- .1 Zurn # Z712;
- .2 Watts Industries (Canada) Ltd. #DX-GF.

2.06 INTERIOR CATCH BASIN FRAMES AND COVERS

- .1 Heavy-duty, 508 mm (13") square, baked epoxy coated cast iron, non-removable, hinged slotted grate with coated steel frame with concrete anchors. Acceptable products are:

- .1 Zurn #Z-799-1;
- .2 Jay R. Smith #8915FC;
- .3 Watts Industries (Canada) Ltd. #FD-410;

2.07 BACKWATER VALVES

- .1 Heat bonded powder epoxy coated cast iron in-line type, each complete with a bolted and gasketed cover, bronze flapper, stainless steel extension, and stainless steel hardware. Acceptable products are:

- .1 Zurn #Z-1095-15-MJ;
- .2 Jay R. Smith #7022.

3 EXECUTION

3.01 SUPPLY OF VENT STACK COVERS

- .1 Supply a properly sized vent stack cover for each vent stack penetrating the roof.
- .2 Hand the vent stack covers to the roofing trade at the site for installation and flashing into roof construction as part of the roofing work. Coordinate installation to ensure proper locations. Provide waterproofing caps over vent stacks.

3.02 INSTALLATION OF CLEANOUTS

- .1 Provide cleanouts in drainage piping in locations as follows:
 - .1 in the building drain or drains as close as possible to the inner face of the outside wall, and, if a building trap is installed, locate the cleanout on the downstream side of the building trap;
 - .2 at or as close as practicable to the foot of each drainage stack;
 - .3 at maximum 15 m (50') intervals in horizontal pipe 100 mm (4") dia. and smaller;
 - .4 at maximum 30 m (100') intervals in horizontal pipe larger than 100 mm (4") dia.;
 - .5 wherever else required in Ontario Building Code.
 - .6 wherever else shown on the drawings.

- .2 Cleanouts are to be the same diameter as the pipe in piping to 100 mm (4") dia., and not less than 100 mm (4") dia. in piping larger than 100 mm (4") dia.
- .3 Where cleanouts in vertical piping are concealed behind walls or partitions, install the cleanouts near the floor and so that the cover is within 25 mm (1") of the finished face of the wall or partition.

3.03 INSTALLATION OF FLOOR CLEANOUT TERMINATIONS

- .1 Where cleanouts occur in horizontal inaccessible underground piping, extend the cleanout TY fitting up to the floor, and provide a cleanout termination set flush with the finished floor.
- .2 In waterproof floors, ensure that each cleanout termination is equipped with a flashing clamp device. Cleanout terminations are to suit the floor finish.
- .3 Where cleanout terminations occur in finished areas, confirm locations prior to rough-in and arrange piping to suit.
- .4 Ensure that cleanout termination covers in tiled floor are square in lieu of round.

3.04 INSTALLATION OF FLOOR DRAINS

- .1 Provide floor drains where shown on the drawings.
- .2 Equip each drain with a trap.
- .3 In equipment rooms and similar areas, exactly locate floor drains to suit the location of mechanical equipment and equipment indirect drainage piping. In washrooms, exactly locate floor drains to avoid interference with toilet partitions.
- .4 Confirm the exact location of drains prior to roughing in. Where floor drains occur in washrooms coordinate locations with toilet partition installations.
- .5 Temporarily plug and cover floor drains during construction procedures. Remove plugs and covers during final cleanup work and when requested, demonstrate free and clear operation of each drain. Replace any damaged grates, and refinish any areas of the drain where the cast iron finish has been damaged or removed, including rusted areas.

3.05 INSTALLATION OF ROOF DRAINS

- .1 Supply roof drains and place roof drain bodies in position for flashing into roof construction as part of the roofing work. Connect with piping and provide accessories.
- .2 Protect roof drains from damage and entrance of debris until roofing work is complete, and refinish any areas where the cast iron factory finish has been damaged or removed, including rusted areas.

3.06 INSTALLATION OF DRAINAGE TRENCH FRAMES AND GRATING

- .1 Supply frame and grating sections for drainage trench as shown. Provide piping connections, traps, etc., as required.
- .2 Hand frames to the concrete trade forming and pouring the trenches. Ensure that frames are properly and accurately installed.
- .3 Be present during the concrete pour to ensure that frames are not dislodged or damaged and remain straight and true. Immediately report any problems.

- .4 Install grates and secure in place. Temporarily cover grates during construction procedures. Clean trenches when work is complete.

3.07 INSTALLATION OF INTERIOR CATCH BASIN FRAMES AND COVERS

- .1 Supply frames and hinged grates for all interior catch basins where shown, and provide all sump inlet and outlet piping and accessories.
- .2 Hand frames to the concrete trade pouring the concrete sump, and coordinate installation of sump piping with the formwork installation.
- .3 Install grates and secure in place. Clean sumps when work is complete.

3.08 INSTALLATION OF BACKWATER VALVES

- .1 Provide backwater valves in drainage piping where shown on the drawings and connect with piping as indicated.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

- .1 **Shop Drawings/Product Data:** Submit shop drawings/product data sheets for all products specified in this Section. Include motor product data sheets, pump curves, and power and control wiring schematics, as well as data for all accessories.
- .2 **Start-Up and Test Data:** Submit, prior to Substantial Performance, start-up or test data specified in Part 3 of this Section.
- .3 **Certification Letters:** Submit pump manufacturer/supplier start-up and installation certification letters as specified in Part 3 of this Section.

2 PRODUCTS

2.01 SUBMERSIBLE SUMP PUMP

- .1 Submersible sump pump as per the drawing schedule, complete with:
 - .1 cast iron pump casing, motor cover and pressure switch housing;
 - .2 an oil filled, overload protected submersible motor with a minimum of 3 m (20') of PVC jacketed power cord prewired to the motor;
 - .3 an open, two-vane type, non-clog cast iron impeller secured to a stainless steel pump and motor shaft;
 - .4 an oil isolated diaphragm type water level control pressure switch with Buna-N rubber diaphragm, and a minimum of 3 m (20') of PVC jacketed control cord prewired to the switch;
 - .5 a high water level alarm switch sealed in a polyurethane float and complete with a minimum of 3 m (20') of PVC jacketed cord;
 - .6 a simplex factory prewired and tested power and control panel complete with a NEMA 3R enclosure with hinged and gasketed padlockable door, galvanized steel back panel with power and control wiring terminal blocks, bundled and identified wiring, and the following:
 - .1 a circuit breaker, a H-O-A switch, an overload protected magnetic motor starter with test and reset pushbuttons, and an identified "RUN" pilot light;
 - .2 a fused control transformer;
 - .3 a solid state pump controller with LED indicator lights;
 - .4 a high level alarm horn with push to silence switch and automatic reset flashing red light;
 - .5 dry contacts for high water level alarm condition connection to a building management system.
- .2 The power and control cords, and high water level float switch cord are to be of sufficient length to extend unbroken from the sump pit through conduit to the wall on which the power and control panel is to be mounted.
- .3 Acceptable manufacturers are:

- .1 Hydromatic Pumps;
- .2 ITT Flygt Canada;
- .3 Barnes Pumps (GSW Pump Company).

2.02 SUBMERSIBLE PUMP SET

- .1 Hydromatic Pumps submersible duplex sump pump set as per the drawing schedule, each pump complete with:
 - .1 a cast iron pump casing and motor cover;
 - .2 an oil filled, overload protected, submersible, ball bearing type, 3 phase motor with a minimum of 3 m (20') of PVC jacketed power cord prewired to the motor;
 - .3 an open, two vane type, non-clog impeller secured to a stainless steel pump and motor shaft;
- .2 Pump set control components supplied by the pump manufacturer are to consist of:
 - .1 four switches, each sealed in a polyurethane float and complete with a minimum of 3 m (20') of control cord, three for pump set control - one for sump high water level alarm;
 - .2 a bracket to support float switch cables in the sump pit;
 - .3 a duplex factory prewired and tested power and control panel complete with a NEMA 3R enclosure with hinged and gasketed padlockable door, galvanized steel back panel with power and control wiring terminal blocks, bundled and identified wiring, and the following:
 - .1 a circuit breaker, a H-O-A switch, an overload protected magnetic motor starter with test and reset pushbuttons, and an identified "RUN" pilot light for each pump, and a relay alternating circuit to automatically alternate the lead pump after each successive pumping cycle;
 - .2 a fused control transformer;
 - .3 a solid state pump controller with LED indicator lights;
 - .4 a high level alarm horn with push to silence switch and automatic reset flashing red light;
 - .5 dry contacts for high water level alarm condition connection to a building management system.
- .3 The pump power cords and the float switch cords must be of sufficient length to extend unbroken through sump pit conduit to the wall on which the starter and control panel is to be located.
- .4 Acceptable manufacturers are:
 - .1 Hydromatic Pumps;
 - .2 ITT Flygt Canada;
 - .3 Barnes Pumps (GSW Pump Company).

2.03 SUMP FRAMES AND COVERPLATES

- .1 Heavy-gauge hot-dipped galvanized steel sump curb frame with concrete anchors and two-leaf minimum 8 mm (5/16") thick continuously hinged blank coverplate, complete with recessed lifting ring, gaskets, reinforced as required to suit the application and loading, and secured to the frame by means of countersunk non-corrosive screws.

3 EXECUTION

3.01 INSTALLATION OF ELEVATOR SUMP PUMP

- .1 Provide a submersible pump on a concrete base in the elevator sump. Refer to the drawing detail.
- .2 Provide all required sump piping, including a shut-off valve and a check valve for the pump. Ensure that piping is easily removable for pump withdrawal from the sump.
- .3 Do not remove the plug from the pump power cord. Pull the power cord through the empty PVC conduit extending from the sump to the receptacle and plug-in the pump.
- .4 Provide sump pit accessories.
- .5 Clean the sump prior to Substantial Performance.

3.02 INSTALLATION OF SUBMERSIBLE DRAINAGE PUMP(S)

- .1 Provide submersible drainage pump(s) in the sump. Refer to the drawing detail.
- .2 Provide all required sump piping, including a shut-off valve and a check valve for each pump. Ensure that valves are readily accessible from floor level and that piping is easily removable for removal of pump(s) from the sump.
- .3 Install float switch(es) at the proper height in the sump and secure cable to a sump wall mounted bracket such that cables cannot twist around each other.
- .4 Leave pump power and control cables outside the sump, neatly coiled, taped and identified for extension and connection to starting and control equipment.
- .5 Hand the pump starter and control panel(s) and high water level alarm panel(s) to the electrical trade at the site for installation.
- .6 Provide sump and pump accessories.
- .7 Clean sump(s) prior to Substantial Performance.
- .8 **Equipment and System Start-Up:** Refer to requirements of the article entitled Equipment and System Start-Up in the mechanical work Section entitled Mechanical Work General Instructions.
- .9 **Manufacturer's Certification:** Refer to requirements of the article entitled Equipment and System Manufacturer's Certification in the mechanical work Section entitled Mechanical Work General Instructions. Submit a copy of the letter prior to Substantial Performance.

3.03 INSTALLATION OF SUMP FRAMES AND COVERPLATES

- .1 Supply a frame and cover for each drainage sump. Carefully coordinate supply of frames and covers with the concrete trade forming and pouring the sumps. Hand frames to the concrete trade for incorporation into the formwork.

- .2 Install gaskets and covers and bolt covers in place.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

- .1 **Product Data Sheets:** Submit product data sheets (fixture cuts) for all plumbing fixtures and fittings. Ensure that the product data sheets confirm that the products proposed meet all requirements of this Section of the Specification.

2 PRODUCTS

2.01 GENERAL RE: PLUMBING FIXTURES AND FITTINGS

- .1 Fixtures and fittings, where applicable, are to be in accordance with requirements of CAN/CSA B45 Series, General Requirements for Plumbing Fixtures, including supplements.
- .2 All barrier-free fixtures and fittings are to be in accordance with governing Code requirements.
- .3 Unless otherwise specified, all vitreous china, porcelain enamelled, and acrylic finished fixtures are to be white.
- .4 Unless otherwise specified, all fittings and piping exposed to view are to be chrome plated and polished.
- .5 All fittings located in areas other than private washrooms are to be vandal-proof.
- .6 **Fixture Carriers:** All fixture carriers are to be suitable in all respects for the fixture they support and the construction in which they are located.
- .7 **Water Closet Floor Flanges:** Floor flanges for floor mounted water closets are to be cast iron or brass, secured to the floor to prevent movement and complete with a wax seal and brass or stainless steel bolts, nuts, and washers. Plastic floor flanges will not be acceptable.
- .8 **Water Closet Wall Seals:** Proper seal to mate with the fixture carrier flange and produce a water-tight installation.
- .9 **Fixture Exposed Traps:** Exposed traps for fixtures not equipped with integral traps, such as lavatories, are to be adjustable chrome plated cast brass "P" traps with cleanouts, minimum #17 gauge chrome plated tubular extensions, and chrome plated escutcheons, all to suit the fixture type and drain connection.
- .10 **Fixture Concealed Traps:** Concealed traps for fixtures not equipped with integral traps, such as counter sinks, are to be adjustable cast brass with cleanout plugs, all to suit the fixture type and drain connection.
- .11 **Fixture Exposed Supplies:** Exposed supplies for fixtures which do not have supply trim/fittings with integral stops, i.e. lavatories, are to be solid chrome plated brass angle vales with screwdriver stops for public areas, wheel handle stops for private areas, flexible stainless steel risers, and stainless steel or chrome plated steel escutcheons, all arranged and sized to suit the fixture.
- .12 **Fixture Concealed Supplies:** Water piping as specified, complete with ball type shut-off valves as specified with the water piping, or Dahl Bros. Canada Ltd. ¼ turn Mini Ball Valves.

2.02 PLUMBING FIXTURES AND FITTINGS

- .1 Plumbing fixtures and fittings are to be in accordance with the owners plumbing fixture schedule and specifications for all plumbing fixtures in the suites.
- .2 Refer to interior design drawings and specifications for all plumbing fixtures and fittings in common areas.

2.03 CAULKING

- .1 General Electric Series SCS-1200 Silicone Construction Sealant or Dow Corning 780 silicone rubber sealant with primers as recommended by the sealant manufacturer. Caulking colour(s) for coloured fixtures other than white, if any, will be selected by the Consultant from the sealant manufacturer's standard colour range.

3 EXECUTION

3.01 INSTALLATION OF PLUMBING FIXTURES AND FITTINGS

- .1 Provide all required plumbing fixtures and fittings.
- .2 Confirm the exact location of all plumbing fixtures and trim prior to roughing-in. Refer to architectural plan and elevation drawings.
- .3 When installation is complete, check and test the operation of each fixture and fitting. Adjust or repair as required.
- .4 **Barrier-Free Fixtures:** Comply with mounting height and other requirements of the governing Code(s).
- .5 **Counter Mounted Fixtures and Trim:** Supply templates for all counter mounted fixtures and trim and hand to the trades who will cut the counter. Ensure openings in the counter are properly located.
- .6 **Electronic Flush Valves:** Locate the transformer in the ceiling space above the electronic units to be served. Coordinate locations with the electrical trade who will provide 120 volt line supply to the transformers. Provide low voltage wiring from transformers to each electronic flush valve terminal point. **Note:** All electrical line supply and low voltage wiring is to be concealed and access to the transformer must be provided for servicing.
- .7 **Baths:** Protect all baths from damage during construction and finishing work. Unless otherwise specified, pack concealed voids under baths with batt type glass fibre insulation as the baths are installed.
- .8 **Shower Bases:** Protect all shower bases from damage during construction and finishing work.
- .9 **Shower Fittings:** Confirm exact mixing valve and shower head locations prior to roughing-in.
- .10 **Mop Service Basins:** Set mop service basins on the floor over drain piping and connect to the roughed-in service. Install wall supply trim and any accessories specified.

3.02 CAULKING AT PLUMBING FIXTURES AND FITTINGS

- .1 Caulk around plumbing fixtures and fittings where they contact walls, floors, and any other building surface.

- .2 Clean areas/surfaces to be caulked and prime in accordance with the sealant manufacturer's instructions. Where damage to a building surface may occur, mask the surface to prevent damage and ensure a clean exact edge to the caulking bead.
- .3 Apply caulking using a gun with the proper size and shape of nozzle and force the sealant into joints to ensure good surface contact and a smooth and even finished bead of sealant.
- .4 If joints have been masked the sealant may be tooled in a continuous stroke to obtain complete void filling. Remove masking tape immediately after tooling and before the sealant begins to skin.

3.03 DISHWASHER CONNECTIONS

- .1 Provide water and drain connections for Owner supplied dishwasher consisting of:
 - .1 a 15 mm (½") dia. domestic hot water connection with a Dahl "Mini-Ball" valve with hose end and water hammer arrestor;
 - .2 a 40 mm (1½") dia. DWV copper drain connection with P trap and cleanout plug.

3.04 CLOTHES WASHER CONNECTIONS

- .1 Provide r water and drain connections for Owner supplied clothes washer consisting of:
 - .1 a 15 mm (½") dia. piping connection for both hot and cold water, each terminated in a Dahl "Mini-Ball" Valve with hose end and water hammer arrestor;
 - .2 a 40 mm (1½") dia. standing waste with a height to suit the washer drain and complete with a P trap.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

- .1 **Shop Drawings/Product Data:** Submit shop drawings/product data for all products specified in Part 2 of this Section except for pipe, fittings, and unions. Indicate performance criteria, conformance to appropriate reference standards, and limitations.
- .2 For each gas pressure regulating station, submit:
 - .1 a selection sheet for each PRV, indicating connected equipment, heating loads, design allowance, meter model, body size, spring range and orifice size;
 - .2 a selection sheet for each relief valve(s) serving a PRV.

1.02 QUALITY ASSURANCE

- .1 **Codes and Standards:** All gas system work is to be in accordance with requirements of CAN/CSA-B149.1, Natural Gas and Propane Installation Code, as amended by local Gas Codes.
- .2 **Tradesmen:** All gas system work is to be performed only by licensed gas pipe fitters (holding Gas Technician 1 Certificate) authorized under the TSSA Act.

2 PRODUCTS

2.01 PIPE, FITTINGS AND JOINTS

- .1 **Uncoated Black Steel - Screwed Joints:** Schedule 40 mild black carbon steel, ASTM A53, Grade B, complete with malleable cast iron screwed fittings to ANSI B2.1, and screwed joints.
- .2 **Uncoated Black Steel - Welded Joints:** Schedule 40 mild black carbon steel, ASTM A53, Grade B, mill or site bevelled, complete with factory made forged steel butt welding fittings and welded joints.
- .3 **Copper-Uncoated:** Type "G" seamless copper tubing to ASTM B837, hard temper with wrought copper capillary brazed joint type fittings to ASTM B.61, and brazed joints made with "Sil-Fos" or "Sil-Fos 5" brazing alloy, or, soft temper with flared brass fittings of a single 45° flare type, forged or with a machined long nut and copper to copper threaded connectors, and, where required, flared brass copper to NPS adapters.
- .4 **Flexible Stainless Steel:** Flexible, CSA certified, 860 kPa (125 psi) rated, gas-tight, convoluted stainless steel tubing factory jacketed with a bright yellow PVC coating which is continuously identified. The tubing is to be supplied in coils and is to be complete with factory attached stainless steel end fittings, and adapter unions, protective plates, and steel clamps. Acceptable products are:
 - .1 Tru-Flex Metal Hose LLC. "Pro-Flex";
 - .2 Titeflex Corp. "Gastite";
 - .3 Omega Flex Canada "TracPipe".

2.02 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 **Copper to Steel:** Equal to Kamco Products "Copper Stopper".

2.03 SHUT-OFF VALVES

- .1 **Ball Type:** CSA certified, minimum 3100 kPa (450 psi) WOG rated, 1/4 turn, full port non-lubricated brass ball valves, each complete with a Teflon PTFE seat, chrome plated solid ball, removable lever handle, and screwed ends. Acceptable products are:
 - .1 Neo Valves Inc. #425;
 - .2 Kitz Corp. Code 58;
 - .3 Toyo Valve Co. Fig. 5044A.
- .2 **Plug or Ball Type:** CSA certified, plain face flanged, Class 125, 1380 kPa (200 psi) rated, 1/4 turn, cast iron lubricated plug valves, each wrench operated and complete with cylindrical plug with lubricant grooves, lubricant screw, and lubricant receptacle, or full port carbon steel ball valves with flanged ends. Acceptable products are:
 - .1 Neo Valves Inc. #1AS40114 plug valve;
 - .2 Newman Hattersley #171M plug valve;
 - .3 Kitz Corp. Code No. 150 SCTAM-FS-CGA ball valve.

2.04 NATURAL GAS CONVENIENCE OUTLET

- .1 Neo Valves Model 3/375 quick-connect type CSA certified outlet with interlocking safety cam to prevent release of the appliance connector until the valve is off, integral thermal protection to prevent gas flow if the outlet is exposed to temperatures exceeding 90°C (195°F), and a wall enclosure box. Acceptable manufacturers are:
 - .1 Neo Valves Inc.;
 - .2 Fairview Fittings & Mfg. Ltd.

2.05 PRESSURE REGULATORS

- .1 CSA certified pressure regulators as follows:
 - .1 **non-vented type:** lever action, dead end lockup type, each complete with a vent limiter, self-aligning valve, die-cast aluminium housing, and synthetic rubber compound diaphragm;
 - .2 **vented type:** spring-loaded self-operated design, tight closing, selected for the facility gas pressure and piping pressure loss, and connected equipment load at full firing rate plus 20% spare, and complete with:

- .1 1035 kPa (150 psi) rated cast iron body finished with corrosive resistant epoxy enamel;
 - .2 aluminum diaphragm and spring case with Nitrile diaphragm, disc, and body o-ring;
 - .3 throttling type, high flow rate, tight shut-off relief valve selected to protect equipment downstream of the regulator in coordination with regulator capacity.
- .2 Acceptable manufacturers are:
- .1 Maxitrol Co.;
 - .2 Jordan Valve;
 - .3 Fisher Controls;

3 EXECUTION

3.01 NATURAL GAS SERVICE

- .1 Make all required arrangement with the natural gas supply utility on behalf of the Owner for installation of natural gas service piping with gas pressure regulator and meter assembly where shown.

3.02 NATURAL GAS PIPING INSTALLATION REQUIREMENTS

- .1 Provide all required natural gas distribution piping and connect gas fired or operated equipment, and provide all required vent piping to atmosphere, including vent piping from pressure regulators. Do all piping work in accordance with requirements of CAN/CSA-B149.1, Natural Gas and Propane Installation Code, as amended by local Gas Codes.
- .2 Piping is to be as follows:
 - .1 for underground piping, coated Schedule 40 black steel, coated soft copper;
 - .2 for above ground piping, uncoated Schedule 40 black steel, hard temper or soft copper, or, if permitted, flexible stainless steel.
- .3 Install flexible stainless steel pipe in strict accordance with the pipe manufacturer's printed instructions.
- .4 Slope gas piping in the direction of flow to low points.
- .5 Ensure that supports for roof mounted piping are sized (height) to accommodate the roof slope and the required piping slope, and to permit the installation of low point dirt pockets.
- .6 Provide full pipe diameter 150 mm (6") long drip pockets at the bottom of all vertical risers, at all piping low points, and wherever else shown and/or required.
- .7 Identify all natural gas piping above ground with two coats of safety yellow enamel applied over primer, and SMS Ltd. or equal coil type vinyl identification makers with arrows.

- .8 For all underground gas piping, provide continuous 75 mm (3") wide yellow PVC warning tape with "CAUTION - GAS LINE BURIED BELOW" wording at 750 mm (30") intervals located above the pipe approximately 250 mm (10") below grade.

3.03 INSTALLATION OF SHUT-OFF VALVES

- .1 Provide CSA approved ball type or lubricated plug type shut-off valves to isolate equipment, and wherever else shown.
- .2 Ensure that valves are located for easy accessibility and maintenance.

3.04 INSTALLATION OF NATURAL GAS CONVENIENCE OUTLETS

- .1 Provide natural gas convenience outlets and wall mount where shown.
- .2 Provide a shut-off valve in connecting piping, confirm exact location prior to roughing-in, and ensure that the outlet is rigidly secured in place.

3.05 INSTALLATION OF PRESSURE REGULATORS

- .1 Provide pressure regulators in gas distribution piping where indicated and/or required.
- .2 For indoor appliances, use lever acting design vent limiter type, sized as shown and mounted in a horizontal upright position in strict accordance with the manufacturer's instructions. Note that these pressure regulators do not require vent piping.
- .3 Use vented type pressure regulators for all other applications.
- .4 Install regulating stations in accordance with requirements of CAN/CSA-B149.1.
- .5 Provide 6 mm (¼") diameter test ports upstream and downstream of each regulator assembly.
- .6 Locate outdoor regulating stations a minimum of 300 mm (12") away from walkways, and 3 m (10') away from equipment air intakes and building openings. Provide all required vent piping and terminate vents in a turn-down elbow fitting with bronze bug screen secured in place.
- .7 Locate indoor regulating stations in locations accessible without the use of ladders or lifts. Combine vents where permitted and increase vent pipe size accordingly. Extend vent piping up through the roof 3 m (10') away from equipment air intakes and building openings and terminated in a turn-down elbow fitting with bronze bug screen secured in place.
- .8 Indicate operating set-points, relief settings and vent arrangements for each regulating station on as-built record drawings.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

- .1 **Shop Drawings/Product Data:** Submit shop drawings/product data sheets for all products specified in this Section except piping and unions.

2 PRODUCTS

2.01 PIPE, FITTINGS AND JOINTS

- .1 **Black Steel - Screwed Joint:** Mild black carbon steel, Grade B, 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, 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, ASTM A53, factory or site roll grooved, complete with Victaulic cast ductile iron grooved end fittings, including full flow elbows, conforming to ASTM A536, and Victaulic Style 107 "QuickVic" rigid couplings for sizes 50 mm (2") to 200 mm (8"), Victaulic Style 07 "Zero-Flex" rigid couplings for sizes 250 mm (10") to 300 mm (12"), Victaulic Style W07 AGS rigid couplings for sizes 350 mm (14") to 1525 mm (60").
- .4 **Soft Copper Pipe:** Type "L" seamless soft copper to ASTM B77.
- .5 **Hard Copper - Solder Joint:** Type "L" hard drawn seamless copper to ASTM B88, complete with wrought copper fittings to ANSI B16.22, and 95% tin/5% Antimony solder joints.
- .6 **Hard Copper - Pressure Coupled Joint:** Type "L" hard drawn seamless copper to ASTM B88, complete with Rigid Tool Co. "ProPress with Smart Connect feature" system copper fittings with EDPM seals, and pressure type crimped joints made by use of a Rigid Tool Co. Model RP 330 or Model RP 210 electro-hydraulic crimping tool.

2.02 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.

2.03 SHUT-OFF VALVES

- .1 **Ball Type:** Class 600, 4140 kPa (600 psi) WOG rated full port ball valves, each complete with a forged brass or bronze body and cap, blowout-proof stem, solid forged brass chrome plated ball, "Teflon" or "PTFE" seat, threaded ends, and removable lever handle. Acceptable products are:
- .1 Toyo Valve Co. Fig. 5044A;

- .2 Kitz Corp. Code 58;
- .3 Victaulic Co. of Canada Ltd. Series 722;
- .2 **Butterfly Type:** Cast ductile iron, lug body style, 1200 kPa (175 psi) rated butterfly valve, each complete with a neck to permit 50 mm (2") of insulation above the flange, a field replaceable EPDM seat, ductile iron disc, stainless steel shaft with EPDM seal, a lever handle for valves to and including 150 mm (6") diameter, a handwheel and gear type operator for valves larger than 150 mm (6") diameter, and each suitable for bubble-tight dead end service with the valve closed and either side of the connecting piping removed. Acceptable products are:
 - .1 Victaulic Co. of Canada Ltd. Vic-300 MasterSeal or AGS Vic-300;
 - .2 Apollo Valve 143 Series;
 - .3 Kitz Corp. 6112 Series;
 - .4 Toyo Valve Co. 918DESL/G2.

2.04 SWING CHECK VALVES

- .1 **Bronze - Screwed:** Class 125, 1380 kPa (200 psi) WOG rated horizontal swing check valves, each complete with a "Y" pattern bronze body, hinged brass disc, easy access screw-in cap, and screwed ends. Acceptable products are:
 - .1 Toyo Valve Co. Fig. 238;
 - .2 Nibco #T-433;
 - .3 Kitz Corp. Code No. 29.
- .2 **Steel - Grooved Ends:** Victaulic Co. of Canada Ltd. Series 716, 779 or W715 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 a bronze disc and seat, malleable iron hinge, bolted cover, and screwed or flanged ends as required. Acceptable products are:
 - .1 Toyo Valve Co. Fig. 435A;
 - .2 Watts Industries (Canada) Inc. #F-511;
 - .3 Kitz Corp. Code No. 78.

2.05 DRAIN VALVES

- .1 Minimum 2070 kPa (300 psi) WOG rated, 20 mm ($\frac{3}{4}$ ") diameter straight pattern bronze ball valves, each complete with a threaded outlet suitable for coupling connection of 20 mm ($\frac{3}{4}$ ") diameter hose, and a cap and chain. Acceptable products are:
 - .1 Toyo Valve Co. Ltd. Fig. 5046;
 - .2 Kitz Corp. Code No. 68AC;

- .3 Apollo Valves #78-104-01.

2.06 CIRCUIT BALANCING VALVES

- .1 Screwed or flanged as required, globe style, non-ferrous circuit balancing valves designed to facilitate precise flow measurement, precision flow balancing, and positive shut-off, complete with capped and valved drain connection, and valved ports for connection to a differential pressure meter. Acceptable products are:

- .1 S.A. Armstrong Ltd. Series "CBVI" screwed or "CBVII" flanged;
- .2 Victaulic Co. of Canada Ltd. (Tour & Anderson) Series 787 screwed, Series 788 flanged, and 789 grooved end, and Series 78K "Koil Kit" valves.

2.07 RADIATOR SHUT-OFF AND BALANCING VALVES

- .1 Heavy pattern, straight, 1750 kPa (250 psi) rated at 120°C (250°F) bronze radiator valves, each complete with composition disc, spring loaded packing, and union. Inlet valves are to be equipped with a handle for shut-off. Outlet valves are to be equipped with a lockshield for shut-off and balancing. Acceptable products are:

- .1 Dahl Brothers Canada Ltd. #11042 and #13013;
- .2 Spirax Sarco Ltd. Type R.

3 EXECUTION

3.01 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;
 - .2 for pipe 65 mm (2½") to 300 mm (12") diameter and larger, Standard weight black steel (10 mm/0.375" thickness) with grooved ends and Victaulic fittings and couplings, or, Standard weight black steel (10 mm/0.375" thickness) with welding fittings and welded joints;
 - .3 for short branch connections to heating equipment where structural obstructions occur and site bending of pipe is advantageous, a single length of type "L" soft copper.
- .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:** Provide a drain valve at the base of each piping riser, in drain connections to equipment, in low points of horizontal piping, and wherever else shown and/or specified.
- .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.

3.02 FLUSHING AND CLEANING PIPING

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

3.03 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

1.01 SUBMITTALS

- .1 **Shop Drawings/Product Data:** Submit shop drawings/product data sheets for all products specified in this Section. Shop drawings and product data sheets must confirm that the products proposed meet all requirements of the Contract Documents.
- .2 **Colour Chart(s):** Submit manufacturer's colour chart(s) for all items for which a finish colour is to be selected.

2 PRODUCTS

2.01 SPLITTER DAMPERS

- .1 Minimum #20 gauge damper blade constructed of the same material as the duct, reinforced as required to suit blade size, system velocity, and to prevent "chatter", and complete with operating hardware equal to Dyn Air Inc. #Q-50 "DYN-A-QUAD S-S" quadrant regulator with RW-50 backup washers to prevent leakage, long square bearing pin, and slide pin.

2.02 AIR TURNING VANES

- .1 For square elbows - multiple-radius turning vanes, interconnected with bars, adequately reinforced to suit the pressure and velocity of the system, constructed of the same material as the duct they are associated with, and in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

2.03 MANUAL BALANCING (VOLUME) DAMPERS

- .1 Flanged and drilled, single or parallel blade (depending on damper size) manual balancing dampers, each constructed of the same material as the connecting ductwork unless otherwise specified, each designed to maintain the internal free area of the connecting duct, and each complete with:
 - .1 a hexagonal or square shaft extension through the frame;
 - .2 non-stick, non-corrosive synthetic bearings for rectangular dampers, flange stainless steel bearings for round dampers;
 - .3 blade stops for single blade dampers, designed to prevent the blade from moving more than 90°;
 - .4 linkage for multiple blade dampers;
 - .5 a locking hand quadrant damper operator with, for insulated ducts 50 mm standoff mounting.
- .2 **Rectangular Dampers:** Nailor Industries Inc. #SP1010 FF 16G LC BS NS, maximum size 1.2 m x 1.2 m (4' x 4') for a single damper.
- .3 **Round Dampers:** Nailor Industries Inc. #1090 BS, maximum 600 mm (24") diameter, equipped with a minimum 200 mm (8") deep frame, and blade stiffeners where required.
- .4 **Multiple Rectangular Damper Section Assembly:** Rectangular assembly supplied with the dampers or site constructed, of the same material as the damper and designed for tight and secure mounting of the individual dampers.

.5 Acceptable manufacturers are:

- .1 Nailor Industries Inc.;
- .2 Greenheck Fan Corp.;
- .3 Ruskin Co.

2.04 BACKDRAFT DAMPERS

.1 T. A. Morrison & Co. Inc. "TAMCO" counterbalanced backdraft dampers, Series 7000 WT for vertical mounting, Series 7000 CW for down (horizontal) mounting, 65 mm (2½") deep, sized as shown and complete with:

- .1 extruded aluminum frame and blades, minimum 1.58 mm (1/16") thick, with captive extruded silicone blade gaskets and side seals in slots integral with the aluminum extrusions;
- .2 damper blade counterweights internal to the frame and consisting of adjustable weights fastened to brackets which are riveted to the blades;
- .3 dual PVC linkage tracks at each end of the blades, and non-corrosive linkage with hard alloy aluminum pivot arm and Ticona "Celcon" acetal copolymer bearings.

.2 Acceptable manufacturers are:

- .1 Nailor Industries Inc.;
- .2 Greenheck Fan Corp.;
- .3 Ruskin Co.

2.05 FUSIBLE LINK DAMPERS

.1 Curtain blade type, dynamic, galvanized steel (unless otherwise specified) fusible link dampers, ULC classified to Standard CAN/ULC-S112 and in accordance with NFPA 90A requirements, factory tested for closure under airflow, 1 1/2 hour or 3 hour rated as required, and complete with a constant force type 301 stainless steel closure spring, a blade lock assembly, a steel sleeve, retaining angles, and, unless otherwise specified, a 74°C (165°F) rated standard fusible link.

.2 Fusible link dampers are to be Type "B" or Type "C" (as required) with the folded curtain blade out of the air stream except where damper size or location requires the use of type "A" dampers with the curtain blade in the air stream.

.3 Acceptable fusible link damper manufacturers are:

- .1 Nailor Industries Inc.;
- .2 Greenheck Fan Corp.;
- .3 Ruskin Co.

2.06 COMBINATION FIRE/SMOKE DAMPERS

- .1 Multi-blade type, fail-safe, dynamic, galvanized steel (unless otherwise specified) combination fire/smoke dampers, ULC classified to Standard CAN/ULC-S112, 1 1/2 hour fire rated, leakage Class I smoke rated, normally closed, low pressure drop design, dynamically tested, type "B" or "C" as required, each complete with jamb and blade seals, linkage concealed in the frame, a steel sleeve to suit the fire barrier opening, a fusible link to close and lock the damper without disengaging the actuator, and an electric 115 volt actuator to automatically close the damper upon receiving an external signal, and to automatically open the damper when the system is reset.
- .2 Acceptable combination fire/smoke dampers are:
 - .1 Nailor Industries Inc.;
 - .2 Greenheck Fan Corp.;
 - .3 Ruskin Co.

2.07 FLEXIBLE CONNECTION MATERIAL

- .1 Waterproof, indoor-outdoor type flexible connection material meeting requirements of NFPA 90A, consisting of woven glass fibre fabric coated on both sides with synthetic rubber. Acceptable products are:
 - .1 Duro Dyne Canada Inc. "DUROLON";
 - .2 Dyn Air Inc. "HYPALON".

2.08 ROOF DUCT SUPPORTS

- .1 Equal to Lexcor (Lexsoco Corp.) Series SS-A215 "Flash-Tite" adjustable height, insulated aluminum structural supports, each complete with two-piece telescoping flashing, a baseplate to suit the application, a threaded cap with plate, and a 12 mm x 40 mm (½" x 1½") threaded stainless steel top stud.

2.09 DUCT ACCESS DOORS

- .1 In accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, with sizes suitable in all respects for the purpose for which they are provided, and, unless otherwise specified, constructed of the same material as the duct they are associated with.

2.10 DUCTWORK DRAIN POINTS

- .1 Equal to Ductmate Canada Ltd. "DUCTMATE MOISTURE DRAIN", 20 mm (¾") diameter moisture drains with galvanized sheet metal funnel, and chrome plated brass threaded drain, nut and cap.

2.11 WIRE MESH (BIRDSCREEN)

- .1 Heavy-gauge galvanized steel or aluminum mesh, 12 mm x 12 mm (½" x ½") secured in a rigid galvanized steel or aluminum framework, sized as indicated on the drawings, and constructed so as to be removable.

2.12 LOUVRES

- .1 Price Industries Inc. DE439 or DE63 100 mm (4") or 150 mm (6") deep (to suit wall thickness) factory assembled stationary, drainable, storm-proof louvres sized as indicated on the drawings, each AMCA water penetration and air performance certified, constructed of welded, extruded, alloy 6063-T5 aluminum with drainable blades, mounting and securing hardware to suit the application, and 12 mm (½") mesh aluminum birdscreen in an aluminum frame.
- .2 **Acoustical Louvres:** Price Industries Inc. Model QA1245 300 mm (12") deep, welded, extruded alloy 3003-H14 aluminum, storm-proof, stationary, drainable acoustical louvers, AMCA water penetration and air performance certified, with high density mineral wool acoustic media secured to blades and protected by perforated aluminum, sound ratings in accordance with ASTM E90-81 and ASTM E413-73, and mounting and securing facilities as required.
- .3 Louvres are to be factory finished with a finish equal to PPG Industries "Duranar" fluoropolymer powder coating over primer with colour as selected from the manufacturer's standard colour range.
- .4 Acceptable manufacturers are:
 - .1 Price Industries Inc.;
 - .2 Nailor Industries Inc.;
 - .3 Greenheck Fan Corp.

2.13 MOTORIZED CONTROL DAMPERS

- .1 T.A. Morrison & Co. Inc. "TAMCO", 100 mm (4") deep, flanged aluminum control dampers with AMCA certified maximum leakage through a 1.2 m x 1.2 m (4' x 4') damper of 52 L/s/m² (110 ft³/min) against 1 kPa (0.145 psi) differential static pressure. Control dampers for mixing applications are to be parallel blade type. Control dampers for open-shut service are to be opposed blade type.
- .2 **Standard Damper:** Series 1000 dampers complete with:
 - .1 extruded 6063T5 aluminum frame and blades, each with an integral slot to receive a gasket;
 - .2 extruded silicone frame gaskets and extruded EPDM blade gaskets;
 - .3 slip-proof aluminum and corrosion resistant plated steel linkage concealed in the frame, equipped with self-sealing and self-lubricating bearings consisting of a Ticona "Celcon" inner bearing fixed on the hexagonal blade pin and rotating in a polycarbonate outer bearing inserted in the frame.

3 EXECUTION

3.01 INSTALLATION OF SPLITTER DAMPERS

- .1 Provide splitter dampers in supply ductwork at branch duct connections off supply air mains, and wherever else shown and/or specified on the drawings. Install splitter dampers so they cannot vibrate and rattle and so that the damper operation mechanisms are in an easily accessible and operable location. Ensure that operators for dampers in insulated ducts are equipped with stand-off mounting brackets.

3.02 INSTALLATION OF TURNING VANES

- .1 Provide turning vanes in ductwork elbows where shown on the drawings and wherever else required where, due to site installation routing and duct elbow radius, turning vanes are recommended in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

3.03 INSTALLATION OF MANUAL BALANCING (VOLUME) DAMPERS

- .1 Provide manual balancing dampers in all open end ductwork, in all duct mains, and wherever else shown and/or specified.
- .2 Install the dampers so that the operating mechanism is accessible and positioned for easy operation, and so that the dampers cannot move or rattle. Ensure that operating mechanisms for dampers in insulated ducts are complete with stand-off mounting brackets.
- .3 Where a duct for which a balancing damper is required has dimensions larger than the dimensions of the maximum size volume damper available, provide multiple dampers bolted together in a properly sized assembly, or bolted to a heavy-gauge black structural steel angle or channel framework which is properly sized. Seal to prevent air by-pass, and provide connecting linkage.
- .4 Confirm exact damper locations with personnel doing air quantity balancing testing work and install dampers to suit. Include for providing five additional dampers at no additional cost.

3.04 INSTALLATION OF BACKDRAFT DAMPERS

- .1 Provide backdraft dampers where shown.
- .2 Install and secure the dampers so that they cannot move or rattle.

3.05 INSTALLATION OF FUSIBLE LINK DAMPERS

- .1 Provide fusible link dampers where shown and/or specified on the drawings. Ensure that the damper rating (1½ or 3 hr.) is suitable for the fire barrier it is associated with.
- .2 Install dampers with retaining angles on all four sides of the sleeve on both sides of the damper and connect with ductwork in accordance with the damper manufacturer's instructions and details to meet Code requirements.
- .3 Provide expansion clearance between the damper or damper sleeve and the opening in which the damper is required. Ensure that the openings are properly sized and located, and that all voids between the damper sleeve and the opening are properly sealed to maintain the rating of the fire barrier.
- .4 Where the size of the fire barrier opening requires the use of a sectionalized fire damper assembly, provide multiple fusible link dampers (sized to CAN/ULC - S112) bolted together in a properly sized assembly or bolted to a heavy-gauge black structural steel angle or channel framework.
- .5 Type "A" damper is not accepted unless approved by mechanical consultant.

3.06 INSTALLATION OF COMBINATION FIRE/SMOKE DAMPERS

- .1 Provide combination fire/smoke dampers where shown and/or specified on the drawings. Install dampers with retaining angles on all four sides of each side of the damper, and, where required, connect with ductwork, all in accordance with the damper manufacturer's instructions and details, and Code requirements.

- .2 Coordinate damper installation with the electrical work where electrical connections to damper actuators are specified.

3.07 INSTALLATION OF FLEXIBLE CONNECTION MATERIAL

- .1 Provide a minimum of 100 mm (4") of flexible connection material where ducts, plenums, and/or easings connect to fans, and wherever else shown or specified.
- .2 Rigidly secure a minimum of 75 mm (3") of duct material (minimum #24 gauge) to each edge of the flexible fabric and to the fan, duct, plenum, etc., in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible. Ensure that connections to the flexible fabric material are arranged and supported so as to not impose any external forces on the fabric.

3.08 INSTALLATION OF ROOF MOUNTED DUCT SUPPORTS

- .1 Supply supports for roof mounted ductwork as indicated.
- .2 Hand the adjustable structural supports to the roofing trade on the roof for installation and flashing into roof construction as part of the roofing work. Accurately mark the exact locations and spacing of the structural supports and supervise installation. Provide properly sized hot dip galvanized structural steel angles between structural supports and secure in place on support studs. Support ductwork on the angles and provide galvanized steel banding to secure ducts to the angles.

3.09 INSTALLATION OF DUCT ACCESS DOORS

- .1 Provide access doors in ductwork for access to all components which will or may need maintenance and/or repair, including reheat coils. Install in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.
- .2 Identify access doors provided for fusible link damper maintenance with "FLD" stencil painted or marker type red lettering and ensure that the doors are properly located for damper maintenance.
- .3 When requested, submit a sample of proposed duct access doors for review.
- .4 Where sectionalized fusible link dampers and/or balancing dampers are provided in large ducts, provide a plenum type access door to suit, and adequately reinforce the ductwork to suit the access door installed.

3.10 INSTALLATION OF WIRE MESH (BIRDScreen)

- .1 Provide framed, removable wire mesh panels over openings in ducts and/or walls where shown and/or specified on the drawings. Rigidly secure in place but ensure the panels are removable.
- .2 Provide wire mesh panels for open-end return air ducts in ceiling spaces whether shown on the drawings or not.

3.11 INSTALLATION OF LOUVRES

- .1 Provide louvres for wall openings where shown.
- .2 Install louver assemblies and secure in place in accordance with the manufacturer's instructions and details.
- .3 Confirm exact louver sizes and finish prior to ordering.

3.12 INSTALLATION OF MOTORIZED CONTROL DAMPERS

- .1 Provide motorized control dampers where shown. Secure in place to prevent movement or rattle, and to prevent air bypass around the damper.
- .2 Provide insulated dampers in fresh air intake ductwork or openings, and for exhaust air service at exterior walls.
- .3 Equip each damper with an electric motor actuator, 120 volt or 24 volt as required. Ensure that each actuator is equipped with all required features to suit the application.

3.13 CONTROL WIRING

- .1 Provide all required power wiring for controls from 15A-1P circuits terminated in junction boxes adjacent to the control work, and do all control wiring to connect control components.
- .2 Install wiring in conduit in accordance with electrical work wiring material and installation requirements.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

- .1 **Shop Drawings/Product Data:** Submit shop drawings/product data sheets for inline fans and accessories. Shop drawings/product data sheets must confirm that the fans conform to requirements of the Contract Documents. Include the following:
 - .1 certified fan performance curves;
 - .2 product data for all accessories;
 - .3 product data for fan motors.

1.02 QUALITY ASSURANCE

- .1 Inline fan manufacturers are to be current members of the Air Movement and Control Association International Inc. (AMCA), and the fans are to be rated (capacity and sound performance) and certified in accordance with requirements of the following standards:
 - .1 ANSI/AMCA Standard 210, Laboratory Method of Testing Fans for Certified Aerodynamic Performance Rating;
 - .2 AMCA Standard 211, Product Rating Manual for Fan Air Performance;
 - .3 ANSI/AMCA Standard 300, Reverberant Room Method for Sound Testing of Fans;
- .2 **Acceptable Manufacturers:** Acceptable centrifugal inline fan manufacturers are:
 - .1 Penn Ventilation;
 - .2 Reversomatic;
 - .3 Greenheck Fan Corp.;

2 PRODUCTS

2.01 CEILING MOUNTED FANS

- .1 ULC listed and labelled ceiling mounted ntrifugal, AMCA rated and certified (capacity and sound to AMCA Standards 211 and 311), exhaust fans as per the drawing schedule, complete with:
 - .1 **housing:** minimum #20 gauge galvanized steel housing equipped with duct connection collar(s), integral spring loaded aluminum backdraft damper, 12 mm (½") thick acoustic insulation meeting flame spread and smoke developed rating requirements of CAN/ULC-S102, multi-position mounting brackets, and an integral CSA certified electrical receptacle in an outlet box for plug-in connection of the fan motor;
 - .2 **fan wheel and motor:** low RPM, resiliently mounted, direct connected assembly with a forward curved, statically and dynamically balanced galvanized steel or calcium carbonate filled polypropylene centrifugal wheel direct connected to a single phase motor conforming to requirements specified in the mechanical work Section entitled Basic Mechanical Materials and Methods and equipped with a length of power cord and plug;

- .3 **exhaust grille:** for fans as indicated and/or scheduled, a white calcium carbonate exhaust grille;

2.02 SIDEWALL PROPELLER FANS

- .1 Axial flow type, ULC listed, AMCA rated and certified (capacity and sound to AMCA Standards 211 and 311), factory run tested propeller fans as per the drawing schedule, with fan performance (sound and air) based on tests conducted in accordance with AMCA Standards 210 and 300.
- .2 Drive Frame and Fan Panel: Heavy-gauge galvanized steel drive component frame bolted or welded to the formed galvanized steel fan panel equipped with formed flanged edges, pre-punched mounting holes, and a deep formed inlet venturi.
- .3 Propeller: Fabricated steel blades unless otherwise specified, welded to a heavy-gauge steel hub and dynamically balanced.
- .4 Fan Shaft and Bearings: For belt-drive fans only, AISI 1045 cold rolled steel shaft, accurately turned, ground, and polished, and sized for a first critical speed of at least 1.25 times the maximum rated speed for the fan, and grease lubricated or permanently lubricated, sealed, ball type pillow block bearings selected for an AFBMA L-50 minimum average life in excess of 200,000 hours at maximum fan RPM.
- .5 Drive and Guard: For belt-drive fans only, variable pitch adjustable V-belt drive with guard conforming to requirements of Section 15010.
- .6 Motor: In accordance with requirements specified in Section 15010.
- .7 Finish: Unless otherwise specified, all bare steel surfaces are to be cleaned, primed, and factory finished with epoxy equipment enamel.
- .8 Accessories: For fans as scheduled, factory supplied accessories as follows:
 - .1 #16 gauge G90 galvanized steel wall box with removable screen guard, equipped with mounting flanges with pre-punched holes;
 - .2 backdraft damper with galvanized steel frame, aluminum blades with felt edge seals, stainless steel shaft, and OSHA damper guard;
 - .3 galvanized steel weatherhood with removable galvanized steel wire mesh birdscreen, with mounting flanges equipped with pre-punched mounting holes;
 - .4 an OSHA motor side guard with galvanized steel side panels and removable galvanized steel wire mesh screen.

2.03 CENTRIFUGAL INLINE FANS

- .1 Centrifugal, ULC listed, factory run tested rectangular inline fans as per the drawing schedule.
- .2 **Housing:** Heavy-gauge galvanized steel with removable side panels to permit removal of the power assembly without disturbing duct connections, universal mounting brackets and hardware including spring vibration isolators to accommodate horizontal or vertical mounting as required, a flanged inlet panel with inlet venturi, a flanged outlet panel, both with duct connection collars, and galvanized steel wire grid fan inlet/outlet guard(s).
- .3 **Fan Wheel:** Non-overloading aluminium wheel with backward inclined blades with matching inlet venturi, statically and dynamically balanced as an assembly.

- .4 **Fan Shaft, Bearings, Drive and Guard:** For belt-drive fans only, hot rolled steel shaft, accurately turned, ground, and polished, and sized for a first critical speed of at least 1.25 times the maximum rated speed for the fan, and heavy-duty, self-aligning pillow block type bearings selected for an AFBMA L-50 minimum average life in excess of 500,000 hours and equipped with lubrication line and fitting, and an adjustable V-belt drive with guard conforming to requirements of the mechanical work Section entitled Basic Mechanical Materials and Methods.
- .5 **Motor and Disconnect Switch:** TEFC motor conforming to requirements specified in the mechanical work Section entitled Basic Mechanical Materials and Methods, mounted out of the airstream, complete with a cover, and factory prewired to a NEMA 4 disconnect switch.
- .6 **Accessories:** For fans as scheduled, factory supplied accessories as follows:
 - .1 for fans as scheduled, housing insulation (lining), consisting of neoprene spray coated glass fibre semi-rigid insulation meeting NFPA 90A requirements and 25/50 smoke developed/flame spread requirements of CAN/ULC S102, permanently secured in place with no exposed edges;
 - .2 for fans as scheduled, a galvanized steel filter box with frame suitable for 25 mm (2") thick disposable panel type filters;

3 EXECUTION

- .1 Provide ceiling exhaust fans where shown.
- .2 Secure each ceiling mounted fan housing in place in the ceiling space, flush with the suspended ceiling.
- .3 Secure suspended units in place from the structure, level, and plumb, by means of vibration isolation spring hangers and galvanized steel hanger rods.
- .4 Plug fan motors into housing receptacles.
- .5 Connect fan housings and discharges with ductwork.

3.02 INSTALLATION OF SIDEWALL PROPELLER FANS

- .1 Provide sidewall propeller fans where shown.
- .2 Rigidly secure each fan and accessories in place to the structure in accordance with the fan manufacturer's instructions.

3.03 INSTALLATION OF CENTRIFUGAL INLINE FANS

- .1 Provide inline centrifugal fans where shown.
- .2 Secure each fan in place from the structure with vibration isolation, independent of connecting ductwork and in accordance with the fan manufacturer's published instructions.
- .3 Ensure that duct connections are made using flexible connection material.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

- .1 **Shop Drawings/Product Data:** Submit shop drawings/product data sheets for grilles and diffusers. Shop drawings/product data is to include capacity, throw and terminal velocity, noise criteria, pressure drops, and all other data to confirm that the products proposed meet all requirements of the Contract Documents.

1.02 QUALITY ASSURANCE

- .1 Grilles and diffusers are to be tested and performance certified to the Air-Conditioning and Refrigeration Institute Standard ARI 650, Standard for Air Outlets and Inlets.
- .2 Acceptable manufacturers are:
 - .1 Price Industries Inc.;
 - .2 Titus;
 - .3 Nailor Industries Inc.

2 PRODUCTS

2.01 GRILLES AND DIFFUSERS

- .1 Grilles and diffusers of the type, size, capacity, finish, and arrangement as shown on the drawings and as per the drawing schedule, each equipped with all required mounting and connection accessories to suit the mounting location and application.

3 EXECUTION

3.01 INSTALLATION OF GRILLES AND DIFFUSERS

- .1 Provide grilles and diffusers where shown on the drawings. Wherever possible, grilles and diffusers are to be the product of one manufacturer.
- .2 Unless otherwise specified connect grilles and diffusers in accordance with requirements of SMACNA HVAC Duct Construction Standards Metal and Flexible.
- .3 Exactly locate grilles and diffusers to conform to the final architectural reflected ceiling plans and detailed wall elevations, and to conform to the final lighting arrangement, ceiling layout, ornamental and other wall treatment.
- .4 Equip supply diffusers having a basic four-way or all round air pattern for operation in one, two, or three way pattern where indicated on the drawings.
- .5 Provide sheet metal plenums, constructed of the same material as the connecting duct, for linear grilles and/or diffusers where shown. Construct and install the plenums in accordance with requirements of SMACNA HVAC Duct Construction Standards Metal and Flexible. Where individual sections of linear grilles or diffusers are not equipped with a volume control device, equip the duct connection collar(s) with volume control device(s).
- .6 Where linear type diffusers/grilles are installed in suspended T-bar ceilings, clip the diffusers/grilles in place using clip supplied by the diffuser/grille manufacturer.
- .7 Confirm grille and diffuser finishes prior to ordering.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

- .1 **Shop Drawings/Product Data:** Submit shop drawings/product data sheets for the combo heating system, including control and accessories. Include sound data, certified power and control wiring schematics.
- .2 **Factory Inspection and Test Report:** Submit with delivery of each water heater a copy of the factory inspection and test report, and include a copy of each report with O & M Manual project close-out data.
- .3 **Site Inspection and Start-Up Report:** Submit a site inspection and start-up report from the manufacturer's representative as specified in Part 3 of this Section.
- .4 **Extended Warranty:** Submit a signed copy of the manufacturer's extended warranty for the heat exchanger.

1.02 QUALITY ASSURANCE

- .1 **Codes and Regulations:** water heaters and installation of heaters are to be in accordance with requirements of the following:
 - .1 all applicable Provincial Codes and Standards;
 - .2 CAN/CSA-B149.1, Natural Gas and Propane Installation Codes.
- .2 **Installation Tradesmen:** installation tradesmen are to be journeyman tradesmen licensed to install gas fired equipment.

2 PRODUCTS

2.01 INSTANTANEOUS CONDENSING COMBINATION WATER HEATER

- .1 Furnish and install a Flowmax instantaneous condensing combination water heater available from Flowmax Technologies (905-264-1414) www.flowmaxtechnologies.com. The water heating unit shall be a Flowmax 90, 120 or 170 series in size and capacity shown on the drawings, unless otherwise shown or noted. The unit shall be completely factory assembled and tested and include;
 - Primary heat exchanger
 - Main burner
 - Ignition electrode
 - Flame sensor
 - Heating safety thermostat
 - Electronic gas valve
 - Expansion tank
 - Circulation pump with air vent

- Three (3) bar pressure relief valve
 - Water pressure gauge
 - Heating loop fill tap
 - Water pressure switch
 - Heating sensor
 - DHW sensor
 - Three (3) way valve
 - Flow limiter
 - Electronic flow switch
 - Automatic bypass
 - ID fan
 - Flat plate heat exchanger
 - Condensate trap & drain pipe
- .2 Unit shall include pre-wired controls and be suitable for 120/1/60 wiring. All parts shall be mounted within a corrosion resistant cabinet. The complete package shall be ETL approved.
- .3 Unit shall be complete with an automatic fill, pressure reducing valve, from Airmax Technologies, or manufacturer approved equal, field installed and set by Division 15 at 1 bar.
- .4 Warranty
- .1 All components of the system shall carry a five year parts warranty from time of shipment to site by the equipment manufacturer.
- .2 The heat exchanger shall be covered by a 10 year pro-rated parts only warranty from time of shipment.

2.02 FAN COIL SYSTEM (HIGH VELOCITY)

- .1 Furnish and install a High Velocity combo heating and cooling fan coil system available from Airmax Technologies (905-264-1414) www.airmaxtechnologies.com. The fan coil shall be a MaxAir "e" series in size and capacity shown on the drawings, unless otherwise shown or noted. The unit shall be completely factory assembled and tested and include a high capacity hot water coil, blower and motor as required, pre-wired controls and be suitable for 120/1/60 wiring. All parts shall be mounted within a corrosion resistant cabinet. The complete package shall be CSA approved and 3rd party performance verified.
- .2 Each fan coil unit shall be complete with the following :

- .1 Hot water heating coil, nominally sized for operation @ 130°F water temperature, unless otherwise stipulated by water heater source type.
- .2 Blower and 120V, 1750 RPM variable speed, ECM motor with internal overload protection and rubber isolated motor mounts to reduce noise and vibration.
- .3 Multiple return air cut-outs.
- .4 Circulating pump with built-in check valve, (field installed and wired).
- .3 The complete heating coil assembly, including the circulating pump shall be compatible for use with potable water.
- .4 The cabinet shall be constructed of zinc coated, galvanized steel. The air section shall be insulated with 12MM (1/2") Tuff Skin IP 8-10 Acoustic liner. Cabinet to be supported on field supplied and installed neoprene pads or from hangers. Return air openings to be field cut by the installer, according to Airmax size and location details.
- .5 Internal fan coil solid state 24V controls shall run circulating pump control and provide a 24 hr pump exerciser timer, control condensing unit operation, and control fan operation. Division 15 shall supply and install a remote mounted 24V heat/cool thermostat with fan "on-auto" sub-base to control the fan coil. Internally mounted dip switches shall be factory mounted and wired for adjustment of the heating-cooling-fan only CFM by the installer.
- .6 The aluminum fin copper tube hot water heating coil shall be factory mounted within the cabinet. All piping specialties external to the fan coil shall be supplied and installed by the plumbing contractor, to local code and proper design practises.
- .7 A DX cooling coil, from Airmax Technologies, or manufacturer approved equal, complete with freeze stat and metering device of capacity as specified shall be supplied and installed in the return air duct.
- .8 Airmax Technologies shall provide a circulating pump complete with check valve suitable for potable water. Pump must be specifically sized for flow and fluid pressure drop as per unit manufacturer's requirements. Voltage 120/1/60 field wired to the circuit board of the fan coil unit. The pump shall be supplied by the fan coil manufacturer for field installation by the plumbing contractor.
- .9 Ductwork
 - .1 All branch duct, saddles, boots, and diffusers shall be manufactured by Airmax and tested as part of a complete system.
 - .2 The branch duct shall be Airmax Technologies acoustically attenuated supply duct. Duct shall consist of a 5 layer inner perforated liner with a 1" acoustic insulation wrap and an outer mylar vapor barrier. Solid core duct will not be permitted.
- .10 Warranty
 - .1 All components of the system shall carry a two year parts and limited labour warranty from time of shipment to site by the equipment manufacturer on new construction.

3 EXECUTION

3.01 INSTALLATION OF CONDENSING COMBINATION WATER HEATER

United Engineering Inc.

- .1 The combination water heating units shall be supplied and installed per drawings and details.
- .2 The unit is not be used for construction heat.
- .3 The unit shall be mounted with clearances as per the manuals, with suitable space to allow for proper installation and servicing of equipment. Obtain approval of installation from gas utility.
- .4 Water Piping
 - .1 The plumbing contractor will supply and install necessary piping between gas fired water heater and air handler and/or storage tank.
 - .2 Installation to include, but shall not be limited to, the following :
 - Anti-scald mixing valve
 - Insulation valves (ball type)
 - Insulation
 - Lead free solder joints
 - Pump with check valve (supplied by fan coil manufacturer)
 - Drain valve
 - Unions/vents
 - Auto fill valve
 - Motorized control valve(s)
 - Expansion tank
 - All as per local requirements
- .5 Install all components of the hydronic heating systems. System interlock between water heater, fan coil, and storage tank by this division.
- .6 Unit shall be vented with System 636 components as per manufacturer's instructions and local codes.
- .7 Submit complete details and samples of product for review by owner/architect/consultant.
- .8 All installers are required to complete the manufacturers product training before commencing any work.
- .9 A suite mechanical room mock up shall be completed and inspected by Flowmax Technologies to ensure installation correctness/compliance before work commences.

3.02 INSTALLATION OF FAN COIL SYSTEM

- .1 The fan coil units shall be supplied and installed per drawings and details.

- .2 The unit shall not be used for construction heat.
- .3 The unit shall be suitable for multi-positional installation, with suitable space to allow for proper installation and servicing of equipment. Obtain approval of installation from gas utility.
- .4 Ductwork
 - .1 Installing contractor shall supply and install all supply and return air ducting and associated accessories including return air grilles, etc, according to drawings and the manufacturer's installation instructions.
 - .2 The return air ducts shall be internally insulated with 25MM (1") acoustic lining for the first 2.4M (8').
- .5 Provide all materials and/or fittings as may be required.
- .6 The plumbing contractor will supply and install necessary piping between gas fired water heater and air handler.
- .7 Electric
 - .1 Fan motors shall be ECM type, 120/1/60. Division 16 shall extend power to junction box located in the unit and provide a means of disconnect external to unit. Division 15 contractor to run minimum four wire LVT wiring to thermostat. Thermostat wire to be adequate gauge to prevent voltage drops.
 - .2 Fan coil manufacturer supplied circulating pump shall be installed by this Division 15 and wired by Division 16 to fan coil unit.
- .8 Install all components of the air conditioning systems, including air cooled condensing units, DX cooling coils, refrigerant lines, refrigerant, drain lines, disconnects, etc
- .9 The condensing units shall be matched to the fan coil units.
- .10 Submit complete details and samples of product for review by owner/architect/consultant.
- .11 A suite mechanical room mock up shall be completed and inspected by Airmax Technologies to ensure installation correctness/compliance before work commences.

END OF SECTION

1 GENERAL

1.01 SUBMITTALS

- .1 **Shop Drawings/Product Data:** Submit shop drawings/product data sheets for the following:
 - .1 all control system components;
 - .2 identified schematic control diagrams with component identification, catalogue numbers, and sequence of operation for all systems;
 - .3 certified wiring diagrams for all systems.

1.02 QUALITY ASSURANCE

- .1 The control systems are to be installed by the control component manufacturer or by licensed personnel authorized by the control component manufacturer. Submit written confirmation from the control component manufacturer.
- .2 The control system installation company is to have local parts and service availability on a 24/7 basis.
- .3 All control wiring work is to be performed by licensed journeyman electricians, or under direct daily supervision of journeyman electricians.

2 PRODUCTS

2.01 AUTOMATIC CONTROL VALVES AND OPERATORS

- .1 Each control valve must be suitable in all respects for the application, including system pressure, and must have design output and flow rates with maximum pressure drops as follows:
 - .1 chilled water valves for coils: 28 kPa (4 psi);
 - .2 heating water/glycol solution valves for coils: 17.5 kPa (2.5 psi);
 - .3 heating water valves for radiation units: 7 kPa (1 psi);
- .2 Unless otherwise indicated, control valves for proportional operation are to have equal percentage characteristics, and control valves for open/shut two position operation are to have straight line flow characteristics. All valves are to have position indicators. Valves for outdoor applications must be suitable in all respects for the application.
- .3 Heating valves are to be normally open unless otherwise specified.
- .4 Cooling valves are to be normally closed unless otherwise specified.
- .5 **General Re: Valve Operators:** All control valve operators are to be spring return type for fail safe operation, sized to tightly shut the control valves against differentials imposed by the system, equipped with position indicators, and suitable in all respects for the environment in which they are located.
- .6 **Electric Valve Operators:** Equal to Belimo EF Series enclosed reversible gear type operators that can accept modulating control signals as required. Each is to be 1 phase AC, 120 or 24 volt as required or indicated, overload protected, and complete with an enclosure to suit the mounting location.

2.02 CONTROL DAMPERS AND OPERATORS

- .1 T. A. Morrison & Co. Inc. "TAMCO" 100 mm (4") deep, flanged, AMCA low leakage certified aluminium dampers. Dampers for modulating and mixing applications are to be parallel blade type. Dampers for open-shut service are to be opposed blade type. Maximum blade length is to be 1 m (4'). Dampers greater than two sections wide are to be complete with a jackshaft. Each damper is to be complete with:
 - .1 an extruded 6063T5 aluminum frame and airfoil blades, each with an integral slot to receive a gasket;
 - .2 extruded TPE frame gaskets and extruded EPDM blade gaskets;
 - .3 slip-proof aluminium and corrosion resistant plated steel linkage of a metal thickness to prevent warping or bending during damper operation, concealed in the frame, equipped with seal-sealing and self-lubricating bearings consisting of a Celcon inner bearing fixed on the hexagonal blade pin and rotating in a polycarbonate outer bearing inserted in the frame.
- .2 **General Re: Damper Operators:** Each damper motor is to be shaft mounted, spring return, fail safe in the normally open or normally closed position, sized to control the damper against maximum pressure or dynamic closing pressure, whichever is greater, to suit the sizes of dampers involved, and to provide sufficient force to maintain the damper rated leakage characteristics. Each operator is to be complete with a damper position indicator, and external adjustable stops to limit the length of stroke in either direction, and is to be mounted on a corrosion resistant adjustable bracket. Operating arms are to have double yoke linkages and double set screws for fastening to the damper shaft. Operators for dampers are to be connected to the building fire alarm system or to freeze protection devices are to be equipped with additional relays to permit the dampers to respond and go to the required position in less than 15 seconds upon receipt of a signal. Operator enclosures are to be suitable in all respects for the environment in which they are located.
- .3 **Electric Damper Operators:** Equal to Belimo EF Series 24 volt or 120 volt AC spring return, direct coupled electric motor operators for either modulating or two position control as required. Each operator is to be overload protected and complete with an enclosure to suit the mounting location.

2.03 CONTROL SYSTEM COMPONENTS

- .1 Components specified below are required for control of equipment and systems as per the drawing control diagrams and sequences of operation. Not all required components may be specified.
- .2 **Sensor/Transmitter Input Devices:** Sensor/transmitter input devices must be suitable in all respects for the application and mounting location. Devices are to be as follows:
 - .1 **general re: temperature sensors:** resistance type, either two-wire 1000 ohm nickel RTD or two-wire 1000 ohm platinum RTD with accuracy (includes errors associated with the sensor, lead wire, and A to D conversion), equipped with type 316 stainless steel thermowells for pipe mounting applications, as follows:
 - .1 chilled water, room temperature, and duct temperature points, $\pm 1^{\circ}\text{C}$ ($\pm 0.5^{\circ}\text{F}$);
 - .2 all other points, $\pm 0.75^{\circ}\text{C}$ ($\pm 1.3^{\circ}\text{F}$).

- .2 **room temperature sensors:** constructed for surface or recessed wall box mounting, complete with an adjustable set-point reset slide switch with a $\pm 1.66^{\circ}\text{C}$ ($\pm 3^{\circ}\text{F}$) range, individual heating/cooling set-point slide switches as required, a momentary override request pushbutton for activation of after-hours operation, an analogue thermometer;
- .3 **outside air sensors:** designed and constructed for ambient temperatures and to withstand the environmental conditions to which they are exposed, complete with a NEMA/EEMAC 3R enclosure, solar shield, and a perforated plate surrounding the sensor element where exposed to wind velocity pressure;
- .4 **duct mounting sensors:** insertion type with lock nut and mounting plate, designed to mount in an electrical box (weather-proof with gasket and cover where outside) through a hole in the duct;
- .5 **duct/plenum averaging sensors:** for ducts greater than 1.2 m (4') or for ducts where air temperature stratification occurs, averaging type sensors with multiple sensing points, and for plenums for applications such as mixed air temperature measurement to account for air turbulence and/or stratification, an averaging string of sensors with capillary supports on the sides of the duct/plenum;

2.04 SYSTEM WIRING MATERIALS

- .1 System wiring, conduit, boxes, and similar materials are to be in accordance with requirements specified in the appropriate Section(s) of the Electrical Work Division of the specification.

3 EXECUTION

3.01 GENERAL RE: INSTALLATION OF CONTROLS

- .1 Provide complete systems of control and instrumentation to control and supervise building equipment and systems in accordance with this Section of the Specification and the drawings.
- .2 The control systems are to generally be as indicated on drawing control diagrams and are to have all the elements therein indicated or implied.
- .3 The control diagrams show only the principal components controlling the equipment and systems. Supplement each control system with all relays, transformers, sensors, etc., required to enable each system to perform as specified and to permit proper operation and supervision.

3.02 INSTALLATION OF CONTROL AIR PIPING AND TUBING

- .1 Provide all required control air piping and tubing.
- .2 Piping/tubing is to be as follows:
 - .1 for piping mains and branches, type "M" seamless copper;
 - .2 for exposed connections to control components, hard or soft copper tubing;
 - .3 for tubing in accessible ceiling spaces, plenum rated polyethylene, neatly bundled with plastic ties and properly supported;
 - .4 for connections to control components within control cabinets, soft copper or plenum rated polyethylene tubing.

- .3 Properly install and support piping and tubing. Provide suitably sized trap legs with drain valves at all low points to prevent condensation pockets.
- .4 Solder all copper joints except at instruments or panels where compression fittings are to be used.

3.03 SUPPLY OF CONTROL AIR DAMPERS AND OPERATORS

- .1 Unless otherwise specified, supply all required control dampers. Hand the dampers to the sheet metal trade at the site in the location where they are required for installation as part of the sheet metal work. Ensure that each damper is correctly located and mounted.
- .2 Provide linkage and operators for the dampers. Wherever possible locate damper operators so that they are accessible from outside duct, plenum, and equipment casings. Bracket mount operators on ducts or plenums clear of insulation where applicable.
- .3 Where sequence operation is indicated, or where multiple operators drive a series of dampers, provide pilot positioners to couple their action.
- .4 Ensure that dampers located in ductwork other than galvanized steel are constructed of type 316 stainless steel.

3.04 SUPPLY OF AUTOMATIC CONTROL VALVES AND OPERATORS

- .1 Unless otherwise specified, supply all required automatic control valves. Hand the valves to the appropriate piping trades at the site in the locations they are required for installation as part of the piping work. Ensure that each valve is properly located and installed.
- .2 Provide an operator for each valve.

3.05 INSTALLATION OF CONTROL SYSTEM COMPONENTS

- .1 Provide all required control system components and related hardware. Refer to drawing control diagrams and sequences.
- .2 Where components are pipe, duct, or equipment mounted supply the components at the proper time, coordinate installation with the appropriate trade, and ensure that the components are properly located and mounted.

3.06 CONTROL WIRING

- .1 Do all required control wiring from 15A-1P circuits terminated as part of the electrical work in junction boxes in equipment rooms/areas. Coordinate exact junction box locations at the site with the electrical trade.
- .2 Except as specified below, install all wiring in conduit. Unless otherwise specified the final 600 mm (2') connections to sensors and transmitters, and wherever conduit extends across flexible duct connections is to be liquid-tight flexible conduit.
- .3 Control wiring in ceiling spaces and wall cavities may be plenum rated cable installed without conduit but neatly harnessed, secured, and identified.
- .4 All wiring work is to be in accordance with certified wiring schematics and instructions, and the wiring standards specified in the appropriate Sections of the Electrical Work Division of this Specification.

3.07 IDENTIFICATION AND LABELLING OF EQUIPMENT AND CIRCUITS

- .1 Refer to identification requirements specified in the mechanical work Section entitled Basic Mechanical Materials and Methods.
- .2 Identify equipment as follows:
 - .1 **enclosures and components:** engraved laminated nameplates with all wording listed and approved prior to manufacture of the nameplates;
 - .2 **wiring:** numbered sleeves or plastic rings at both ends of the conductor, with numbering corresponding to conductor identification on shop drawings and "as-built" record drawings.

3.08 TESTING, ADJUSTING, START-UP

- .1 **Testing and Adjusting:** When control work is complete, check the installation of components and all wiring connections, make any required adjustments, and coordinate adjustments with personnel doing HVAC testing, adjusting and balancing work.
- .2 **Start-Up:** Refer to the article entitled Equipment and System Start-up in the mechanical work Section entitled Mechanical Work General Instructions.

END OF SECTION

1 GENERAL

1.01 APPLICATION

- .1 This Section specifies vibration isolation product 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.

1.02 SUBMITTALS

- .1 **Product Data:** Submit copies of manufacturer's product data sheets for all products specified in this Section. Product data sheets are to include product characteristics, limitations, dimension, finishes, and installation recommendations.

2 PRODUCTS

2.01 GENERAL

- .1 Vibration isolation products are to be in accordance with Acoustic Report, the drawings and details, and as specified below.
- .2 **Springs:** All springs are to be stable, colour coded, selected to operate at no greater than $\frac{2}{3}$ solid load, designed in accordance with the Society of Automotive Engineers Handbook Supplement 9 entitled Manual on Design and Application of Helical and Spiral Springs, and with spring diameters in accordance with the manufacturer's recommendations to suit the static deflection and maximum equipment load.
- .3 **Finishes:** All steel components of isolation products not exposed to the weather or moisture are to be zinc plated. All steel components of isolation products exposed to the weather or in a damp, moist environment are to be factory painted with rust inhibiting primer and two coats of neoprene.
- .4 Where the weight of isolated equipment may change significantly due to draining or filling with a liquid, vibration isolators are to be equipped with limit stops to limit spring extensions.
- .5 **Flexible Piping Connections:** Flexible piping connections to vibration isolated equipment are specified in the appropriate piping sections of the Specification.

2.02 ISOLATION PADS

- .1 Sandwich type pads, 20 mm ($\frac{3}{4}$ ") nominal thickness, selected for 3.2 mm ($\frac{1}{8}$ ") static deflection unless otherwise specified, consisting of two waffle type or ribbed 50 durometer neoprene pads permanently bonded to a minimum #10 gauge steel plate, and complete with rubber bushed bolt holes and equipment anchor bolts with neoprene isolation grommets. Acceptable products are:
 - .1 Vibro-Acoustics Ltd. Type NSN;
 - .2 Kinetics Noise Control Vibron Products Group Type NGS/NGD;
 - .3 Mason Industries Inc. Type SW/S/SW with HG Bolt Insertion Washers;

2.03 RUBBER FLOOR ISOLATORS

- .1 Captive, bridge bearing quality neoprene mount selected for a minimum 4 mm (0.15") static deflection unless otherwise specified, with an integral ductile iron housing and integral equipment anchor bolt. Acceptable products are:

- .1 Vibro-Acoustics Ltd. Type R;
- .2 Kinetics Noise Control Vibron Products Group Type RQ;
- .3 Mason Industries Inc. Type BR;

2.04 SPRING FLOOR ISOLATORS

- .1 Seismically rated captive spring mount isolator complete with levelling bolts, upper and lower neoprene spring cups, neoprene cushion, ductile iron housing, neoprene sound pads, and neoprene isolation grommets for securing bolts. Acceptable products are:
 - .1 Vibro-Acoustics Ltd. Type SFS;
 - .2 Kinetics Noise Control Vibron Products Group Type FLSS;
 - .3 Mason Industries Inc. Type SSLFH;

2.05 OPEN SPRING MOUNTS

- .1 Base mount free-standing assemblies, each complete with a stable colour coded steel spring welded in place, drilled mild steel mounting plate bonded to a ribbed rubber or neoprene acoustical pad, and an external 16 mm (5/8") diameter level adjustment bolt. Acceptable products are:
 - .1 Vibro-Acoustics Ltd. Type FS;
 - .2 Kinetics Noise Control Vibron Products Group Type FDS;
 - .3 Mason Industries Inc. Type SLFH;

2.06 CLOSED SPRING MOUNTS

- .1 Base mount free-standing enclosed assemblies, each complete with stable colour coded spring(s), two piece cast housing, non-binding rubber horizontal stabilizers, a ribbed rubber or neoprene acoustical pad bonded to the base of the closed housing, and an external level adjustment bolt. Acceptable products are:
 - .1 Vibro-Acoustics Ltd. Type CM;
 - .2 Kinetics Noise Control Vibron Products Group Type FLS;
 - .3 Mason Industries Inc. Type C;

2.07 SPRING HANGERS

- .1 Welded steel plate housing with top and bottom rod mounting holes and spring retainer, neoprene double deflection isolation element, stable colour coded spring, and heavy-duty rubber washers. Acceptable products are:
 - .1 Vibro-Acoustics Ltd. Type SHR-SN;
 - .2 Kinetics Noise Control Vibron Products Group. Type SRH;
 - .3 Mason Industries Inc. Type 30N;

2.08 CONCRETE INERTIA TYPE EQUIPMENT BASE

- .1 Welded steel bases, each complete with a structural black steel channel frame, concrete reinforcing rods, and brackets for spring mounts welded to the frame. Acceptable products are:
 - .1 Vibro-Acoustics Ltd. Type CIB;
 - .2 Kinetics Noise Control Vibron Products Group. Type CIB;
 - .3 Mason Industries Inc. Type KSL;

3 EXECUTION

3.01 INSTALLATION OF VIBRATION ISOLATION MATERIALS

- .1 Provide vibration isolation products for mechanical work in accordance with Acoustic Report, drawings and details, and requirements specified herein and/or on the drawings.
- .2 Supply to the vibration isolation product manufacturer or supplier a copy of a "reviewed" shop drawing or product data sheet for each piece of equipment to be isolated and dimensioned pipe layouts of associated piping to be isolated.
- .3 Unless otherwise specified, all vibration isolation products are to be the product of one manufacturer.
- .4 Ensure that the vibration isolation manufacturer coordinates material selections with equipment provided in order to ensure adherence to performance criteria. Allow for expansion and contraction when material is selected and installed.
- .5 **Isolation for Base Mounted Equipment:** Unless otherwise indicated, install isolation materials for base mounted equipment on concrete housekeeping pad bases which extend at least over the full base and isolated area of the isolated equipment. Additional requirements are as follows:
 - .1 block and shim all bases level so that all ductwork and piping connections can be made to a rigid system at the proper operating level, before isolated adjustment is made, and ensure that there is no physical contact between isolated equipment and the building structure;
 - .2 all steel bases are to clear the sub-base by 25 mm (1");
 - .3 all concrete bases are to clear the sub-base by 50 mm (2").
- .6 **Isolation of Piping:** Isolate all piping larger than 25 mm (1") dia. directly connected to motorized and/or vibration isolated equipment with 25 mm (1") static deflection spring hangers at spacing intervals in accordance with the following:
 - .1 for pipe to and including 100 mm (4") dia. – first three points of support;
 - .2 for pipe 125 mm (5") to 200 mm (8") dia. – first four points of support;
 - .3 for pipe 250 mm (10") dia. and larger – first six points of support;
 - .4 the first point of isolated piping support is to have a static deflection of twice the deflection of the isolated equipment but maximum 50 mm (2");
 - .5 secure the top of the spring hanger frame rigidly to the structure, and do not install spring hangers in concealed locations;

- .6 where it is impossible to use at least two spring hangers, provide Senior Flexonics Ltd. Style 102 (or 102-U as required) or equal, twin sphere, moulded rubber flexible connection assemblies, selected by the manufacturer and suitable in all respects for intended application, and complete with required nipples and connections to provide proper vibration isolation.
- .7 Provide twin sphere expansion joints between the chiller and attached piping, rated for the temperature and pressure.
- .8 Provide twin sphere expansion joints between the cooling tower and attached piping, rated for the temperature connections and pressure.
- .9 Provide win-sphere rubber expansion joints in the vertical pipe sections connecting each pump with the associated piping headers.
- .7 **Roof Curb Isolation:** Erect roof curb vibration isolation in accordance with instructions shipped with the assembly. Match vibration isolation with the associated roof top unit and orient the isolation as identified by manufacturer to ensure proper loading and optimum performance. Caulk the top of the roof curb with two beads of caulking provided and centre the isolation assembly onto roof curb and, unless otherwise noted, screw in place with 50 mm (2") lag screws at 900 mm (36") O.C. Position gasket on top rail or alternatively, caulk with two beads of caulking provided and orient and lower roof top unit onto the isolation rails and, unless otherwise noted, screw unit into top rail with 25 mm (1") lag screws at 900 mm (36") O.C. After roof top unit is secured in place, but before damageable work is installed, spray each isolated equipment assembly with water and correct any water leaks.
- .8 Provide isolated housekeeping pads if required in the Acoustic Report.
- .9 **Manufacturer's Inspection & Certification:** Arrange and pay for the vibration isolation product manufacturer to visit the site to inspect installation of his equipment. Do any revision work required as a result of improper installation. When the vibration isolation equipment manufacturer is satisfied with the installation, obtain and submit a letter stating that he has inspected the installation and that his equipment is properly installed.

END OF SECTION

1 GENERAL

1.01 APPLICATION

- .1 This Section specifies fire stopping and smoke seal 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.

1.02 SUBMITTALS

- .1 **Name & Experience of Proposed Applicator:** Submit for approval the full company name and experience of the proposed firestopping and smoke seal system applicator.
- .2 **Letter of Certification:** Submit a letter of proper firestopping and smoke seal certification as specified in Part 3 of this Section.

2 PRODUCTS

2.01 FIRESTOPPING AND SMOKE SEAL SYSTEM MATERIALS

- .1 Asbestos-free elastomeric materials tested, listed and labelled by ULC in accordance with CAN4-S115 and CAN/ULC-S101 for installation in ULC designated firestopping and smoke seal systems to provide a positive fire, water and smoke seal, and a fire-resistance rating (flame, hose stream and temperature) not less than the fire resistance rating of surrounding fire rated construction.
- .2 Materials are to be compatible with abutting dissimilar materials and finishes and complete with primers, damming and back-up materials, supports, and anchoring devices in accordance with the firestopping manufacturer's recommendations and the ULC tested assembly.
- .3 Pipe insulation forming part of a fire and smoke seal assembly is specified in the Mechanical Insulation Section.

2.02 ACCEPTABLE MANUFACTURERS

- .1 Acceptable firestop and smoke seal manufacturers are:
 - .1 A/D Fire Protection Systems "FIREBARRIER";
 - .2 Tremco Inc. Fire Protection Systems Group "TREMSTOP";
 - .3 3M Canada;

3 EXECUTION

3.01 INSTALLATION OF FIRESTOPPING AND SMOKE SEAL MATERIALS

- .1 Where mechanical work penetrates fire rated construction, provide ULC listed and labelled firestopping and smoke seal materials installed in accordance with requirements of CAN4-S115, CAN/ULC-S101, and all other governing authorities to seal the penetrations.
- .2 **Preparation:** Abide by the following requirements:
 - .1 Examine substrates, openings, voids, adjoining construction and conditions under which the firestop and smoke seal system is to be installed. Confirm compatibility of surfaces.

- .2 Verify penetrating items are securely fixed and properly located with the proper space allowance between penetrations and surfaces of openings.
- .3 Report any unsuitable or unsatisfactory conditions to the Contractor and Consultant in writing, prior to commencement of work. Commencement of work will mean acceptance of conditions and surfaces.
- .4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces. Remove stains on adjacent surfaces.
- .3 **Inspection:** Notify the Consultant when the work is complete and ready for inspection, and prior to concealing or enclosing firestopping and smoke seal materials and service penetration assemblies. Arrange for final inspection of the work by the Municipal Building Inspector prior to concealing or enclosing work. Make any corrections required.

END OF SECTION