Dufferin-Peel Catholic District School Board

STANDARD TEXT GUIDELINE FOR

HVAC System

for

ELEMENTARY AND SECONDARY SCHOOLS

Prepared by the Plant Department

Formatted by the Design Department

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LATEST REVISIONS ARE IN GREEN FONT

1 PREAMBLE

1.1 GENERAL

1.1.1 This Guideline outlines the Board's minimum standards, specific and general requirement for the design of HVAC systems in new and renovated facilities.

1.1.2 These requirements are not intended to be all an encompassing specification, but to act as a guide to the Design Consultant.

1.2 RESPONSIBILITY

1.2.1 Responsibility for the design and performance of the facility systems remains with the Consultant and under no circumstance shall the Consultant be relieved of liability for the design due to this design guide. If the Consultant/Architect is unclear on the requirement of an item covered in this guide, then clarification shall be obtained in writing from the Board.

1.3 REVISIONS TO THE GUIDELINE

1.3.1 This Guideline will be under constant revision and before commencing a new project, the Architect/Engineer/Consultant shall obtain the latest version of the design guide. All revisions to this Guideline will be numbered and dated.

1.4 DEVIATIONS TO GUIDELINE

1.4.1 The Consultant shall generally follow these requirements. If the Consultant wishes to deviate in any form whatsoever, the Board MUST be consulted prior to making such deviations.

1.5 TERMS

1.5.1 The term "Board" in this Guideline refers to "Dufferin-Peel Catholic District School Board".

1.5.2 The term "Consultant" in this Guideline refers to the Mechanical Consulting Engineer appointed for the project.

1.5.3 The term "Engineer" in this Guideline refers to any engineering discipline employed in the design, consulting, or other engineering aspects in the development of the design work.

1.6 CONTRACT CONTROL

1.6.1 This Design Guideline covers work under Division 15, HVAC.

2 DESIGN INTENT

2.1 GENERAL

2.1.1 In consultation with the Project Architect, the Consultant shall present to the Board, both verbally and in writing, a detailed outline of the proposed HVAC Systems.

2.1.2 If there is inadequate information provided in the design brief process, the Board reserves the right to submit a detailed Questionnaire that shall be completed by the Consultant before the actual system design process is started.

2.1.3 A life cycle cost analysis shall be is undertaken and presented, taking into consideration, initial capital, operating and maintenance costs for all systems being considered for a project.

2.1.4 All new Elementary and Secondary shall be centrally air-conditioned using a system appropriate for the building size.

2.1.5 Additions to all buildings shall be air conditioned regardless of mechanical systems in the existing school.

2.1.6 The Consultant shall demonstrate that the proposed systems conform to the requirements of ASHRAE Standard 90.1-2004, Energy Standard for Buildings Except for Low-Rise Residential Buildings, HVAC/Mechanical Code.

2.2 INDOOR AIR QUALITY

2.2.1 Indoor air quality and thermal comfort are high priority items and while the Consultant is free to select the most appropriate system to meet budget constraints, neither of the above factors shall be sacrificed for the sake of cost. .

2.2.2 The Consultant shall demonstrate that the ventilation requirements are in accordance with ASHRAE Standard 62.1-2004, Ventilation for Acceptable Indoor Air Quality

2.2.3 Unless the Consultant can demonstrate and is prepared to guarantee that fresh air quantities can be maintained at ALL TIMES UNDER ALL CONDITIONS, variable air Volume (VAV) systems are not acceptable. Similarly, VVT and any other configurations that varies the air volume are unacceptable for Board facilities.

2.3 DESIGN BRIEF

2.3.1 The Consultant shall prepare a design brief in accordance with ASHRAE Guideline – 1 1996 The HVAC Commissioning Process for the Board's review. The brief shall include, but not be limited to:

2.3.1.1 Detailed description of the Design Intent

2.3.1.2 Detailed description of the Basis of Design

2.3.1.3 Why were these particular systems chosen, based on Life Cycle Cost Analysis

2.3.1.4 What processes will be used in the design and for the selection of equipment or air and hydronic systems?

2.3.1.5 Block building loads

2.3.1.6 Outline of control techniques

2.3.1.7 Overview of system control of major items of equipment

2.3.1.8 Outline of Plumbing systems and materials proposed

2.3.1.9 List of manufacturers being used for design purposes, and the extent of their involvement

3 CODES AND STANDARDS

3.1.1 Design, specifications and installation, shall comply with latest editions and all amendments of the following Authorities and Approval Agencies. Where conflicts occur, higher standards shall apply.

3.1.1.1 Ontario Building Code (OBC)

3.1.1.2 Code and Guide to Part 7 (Plumbing) of the Ontario Building Code

3.1.1.3 Natural Gas and Propane Installation Code, B149.1-00

3.1.1.4 Air Moving and Conditioning Association (AMCA)

3.1.1.5 American National Standards Institute (ANSI)

3.1.1.6 Air Conditioning and Refrigeration Institute (ARI)

3.1.1.7 American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)

3.1.1.8 American Society of Mechanical Engineers (ASME)

3.1.1.9 American Society of Testing and Materials (ASTM)

3.1.1.10 American Water Works Association (AWWA)

3.1.1.11 Building Officials Code Administrators (BOCA)

3.1.1.12 Canadian Electrical Manufacturer's Association (CEMA)

3.1.1.13 Canadian Gas Association (CGA)

3.1.1.14 Canadian Standards Association (CSA)

3.1.1.15 Factory Mutual (FM)

3.1.1.16 Insurer's Advisory Organization (IAO)

3.1.1.17 National Building Code (NBC)

3.1.1.18 National Board of Fire Underwriters (NBFU) – Currently American Insurance Association

3.1.1.19 National Fire Protection Association (NFPA)

3.1.1.20 Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

3.1.1.21 Underwriters' Laboratories of Canada (ULC)

3.1.1.22 Ontario Electrical Code (OEC)

3.1.1.23 Ontario Occupational Health and Safety Act (OHSA)

3.1.1.24 Ministry of Environment (MOE)

3.1.1.25 Ministry of Labour (MOL)

4 PERMITS AND FEES

4.1.1 Except where noted otherwise, the Consultant shall specify that the Prime Mechanical Sub-Contractor shall obtain and pay for all permits and fee required for the execution of his work.

5 COMMISSIONING

5.1.1 The Board shall appoint an independent, qualified, Commissioning Agent to oversee all stages from design through post acceptance of the project. The Consultant shall liaise with the Commissioning Agent to ensure that all-relevant information pertinent to the Commissioning process is reviewed and included as part of the Contract Documents.

5.1.2 ASHRAE Guideline 1-1996-The HVAC Commissioning Process shall be used for all phases of the process and the Consultants shall provide data as may be required by the Board's appointed Commissioning Agent.

5.1.3 The commissioning process is a quality assurance process and shall not abrogate the Consultant from his responsibilities relating to the design, installation, and their performance of the Building Systems

6 TENDER & CONSTRUCTION DRAWINGS

6.1 DRAWINGS

6.1.1 The Consultant shall provide separate drawings using AutoCAD latest edition for:

6.1.1.1 Site Services

6.1.1.2 Plumbing and Drainage

6.1.1.3 Sprinklers and Fire Protection

6.1.1.4 HVAC - Sheet Metal

6.1.1.5 HVAC - Piping

6.1.1.6 Mechanical Rooms - Plan and sections

6.1.1.7 Miscellaneous details

6.1.2 Use metric units on drawings

6.1.3 Provide all standard details and legends on the front page of the mechanical drawings. DO NOT INCLUDE THESE AS PART OF SPECIFICATIONS.

6.1.4 Construction drawings shall be revised to include all addenda issued during the tendering period prior to issuing for construction. Cost of this service shall be included in Consultant's fee.

6.1.5 The Consultant or Contractor shall produce 1:25 scale double line drawings, plan and two sections in opposite directions, as a minimum requirement, of all Mechanical Rooms, fully detailing all ductwork, pipework, valves and controls. These drawings shall be submitted to the Board's Maintenance Department for review before any work is commenced.

6.1.6 Adequate space for the removal and maintenance of mechanical equipment is of prime importance in the layout of equipment. Where applicable, equipment manufacturers' recommendations/ requirements shall be used as a minimum standard.

6.2 SPECIFICATIONS

6.2.1 Specifications shall be written in 3-part format and shall generally follow National Master Specifications (NMS) listing. Provide an index for all major sections. Use metric units with Imperial units in brackets.

6.3 AS-BUILT BRAWINGS

6.3.1 Indicate in the specifications that it is the responsibility of the Mechanical Contractor to obtain one (1) set of white prints form the Consultant prior to starting the work, and to clearly mark any changes made as the installation progresses.

6.3.2 Upon completion of the Project, the Consultant shall review the “As built drawings” provided by the Contractor, make changes as required, and transfer all the information to the AutoCAD drawings.

6.3.3 The “As built drawings” and AutoCAD disks shall be handed over to the Board. Cost of reviewing the “As built drawings” and producing AutoCAD disks shall be included in the Consultant's fees.

7 INSTRUCTION & DEMONSTRATION

7.1.1 Upon completion of the Project, and prior to the Board taking over the operation of the systems, the Commissioning Company shall arrange for the Contractor to instruct Board's representatives in the care, operation, and maintenance of the equipment or systems installed. .

7.1.2 The Commissioning Company shall ensure that the "As Built Drawings" and Operation & Maintenance Manuals are available at the time of demonstration and verify that all equipment is operational. The Consultant shall be present at each demonstration.

7.1.3 The Mechanical Consultant shall co-operate with the Commissioning Company to personally inspect and demonstrate the operation of the completed Mechanical system (all fan units, boilers, motor control centers, etc.)

7.1.4 The Consultant shall specify that during this demonstration, the subcontractors shall have their supervisor in attendance to demonstrate operation of all systems.

7.1.5 An appointment shall be made to carry out these demonstrations as soon as the Commissioning Company, The Board, and the Architect

are satisfied that the systems ***are completely operational*** and are satisfactory in every respect.

8 DOCUMENTATION & OPERATING MANUALS

8.1 GENERAL

8.1.1 Operation and maintenance documentation shall be provided as outlined in ASHRAE *Guideline* 4. This information shall support the training of operation and maintenance staff in preparation for system operation and maintenance.

8.1.2 A complete operation and maintenance documentation package consists of the following:

8.2 OPERATION AND MAINTENANCE DOCUMENT DIRECTORY

8.2.1.1 The operation and maintenance document directory shall provide easy access to information in the operation and maintenance documentation and shall be well organized and clearly identified.

8.3 EMERGENCY INFORMATION

8.3.1 Emergency information shall be immediately available during emergency situations and shall have emergency and staff and/or agency notification procedures.

8.4 OPERATING MANUAL

8.4.1 The operating manual shall contain the following information, as a minimum requirement:

General information
Building function
Building description
Operating standards and logs
Technical Information
System description
Operating routines and procedures
Seasonal start-up and shutdown
Special procedures
Basic troubleshooting

8.5 MAINTENANCE MANUAL

8.5.1 The maintenance manual shall contain the following information, as a minimum requirement:

8.5.1.1 Equipment data sheets

8.5.1.2 General Data

8.5.1.3 Warranty

8.5.1.4 Installation, operation, and maintenance instructions

8.5.1.5 Spare parts inventory

8.5.1.6 Preventive maintenance actions

8.6 TEST REPORTS

8.6.1 The test reports shall document the observed performance during start-up and commissioning.

8.7 SYSTEM MANUAL

8.7.1 The Systems Manual shall provide the information needed to understand, operate and maintain the systems and/or to inform others about the systems. It shall be the repository of all updates and corrections as they occur.

8.7.2 The Systems Manual expands the scope of the operating and maintenance documentation developed in sections 7.4 and 7.5 to include all information gathered by the commissioning process.

8.7.3 The Systems Manual shall include the following:

8.7.3.1 As prescribed in ASHRAE Guideline – 1 1996 The HVAC Commissioning Process Section 12.6.3

8.7.4 Two copies of each manual are required and all written instructions/information produced shall also be provided in Microsoft Word on CD.

8.8 SHOP DRAWINGS

8.8.1 The Mechanical Contractors shall provide 3 sets of shop drawings proposed for use on the project. These drawings shall be forwarded through the contractual routing to the Consultant. The Consultant and Commissioning Agent shall review these drawings. Following the review, the Consultant shall make up one set with combined comments and returns them to the Contractor.

8.9 WARRANTY & MAINTENANCE

8.9.1 The mechanical system in its entirety shall be under warranty by the Mechanical Contractor for 12 months from the first day the building is used as a school or 12 months after substantial completion, which ever is the later.

8.9.2 The General Contractor and the firm's Mechanical Sub-Contractor shall be totally responsible for all labour material and equipment supplied and installed and shall make good any deficiencies or replace at no cost to the Board during the construction or warranty period due to material failure or improper installation.

8.9.3 Extension of manufacture's guarantees and reliance on them for repair is not acceptable.

8.9.4 Refrigeration compressors shall be specified to have a 5-year extended warranty under the same terms.

8.9.5 During the first 12 months of operation as defined above, the Contractor shall carry out routine operating maintenance as required by the various equipment manufacturers.

8.9.6 Ventilation filters in all equipment shall be replaced at substantial completion and at 3month intervals after occupation of the facility. Cost for these changes shall be included in the Mechanical Contract.

8.9.7 All pipeline strainers shall be cleaned and/or replaced with the correct mesh size element after system has been flushed and cleaned. The Mechanical Sub-Contractor shall, one month after occupation, check and clean filters as required.

8.10 SOUND LEVELS

8.10.1 The Consultant shall carry out an acoustical and vibration analysis of the complete mechanical systems to ensure that proper vibration isolation and noise attenuation of mechanical equipment specified to achieve noise criteria levels indicated below.

Administrative areas, Health Room, Guidance	NC 35
Classrooms, Seminar Rooms,	NC 35
Specialized Rooms (Science Art etc.)	NC 35
Library Resource Centre	NC 35
BBT Areas (Shops)	NC 40
Lobby, "Gathering Place" Corridors	NC 30
GP Room/Stage	NC 40
Service and Equipment Rooms	NC 60

8.10.2 The installation shall be inspected and its operation assessed by the Noise Control equipment manufacturer/supplier and a report submitted. Measurements shall be taken when all equipment is operational and when the school is occupied.

8.10.3 Music rooms shall be additionally acoustically treated such that no sound is transmitted to adjacent classrooms/space. Use of HTL (High Transmission Loss) ductwork is recommended for this purpose.

9 TYPES OF HVAC SYSTEMS

9.1 GENERAL

9.1.1 The Consultant may propose any system. However, the following systems are preferred, but in no order of preference.

9.1.1.1 Water Source Heat Pumps

9.1.1.2 Ground Source Heat Pump

9.1.1.3 Chiller/Fan Coil

9.1.1.4 Heat Recovery Chiller constant volume air with terminal reheat

9.2 TYPES OF ACCEPTABLE SYSTEMS

9.2.1 Multiple Standard type Rooftop HVAC systems with energy recovery ventilators to provide the ventilation air as per OBC.

9.2.2 Multiple roof-mounted built-up HVAC systems with DX cooling, indirect fired gas heating and controls are also acceptable.

9.2.3 Multiple indoor mounted heating/cooling air handling units with hot water heating and DX or chilled water cooling with duct mounted reheat coils in each area.

9.3 AREAS NOT REQUIRED COOLING

9.3.1 All areas of the facility shall be heated. Cooling is not required in:

9.3.1.1 Custodian storage rooms

9.3.1.2 Electrical rooms

9.3.1.3 Mechanical rooms

9.3.1.4 Washrooms

9.3.1.5 Stairwells

9.3.1.6 Storage rooms of less than 4.5 m^2 (50 sq. ft.)

9.3.1.7 Gymnasium storage room

9.3.1.8 External storage

9.3.1.9 Sprinkler rooms

9.3.1.10 Workshop (construction, woodwork)

9.3.1.11 Internal garbage rooms

10 HEATING & AIR CONDITIONING SYSTEM

10.1 GENERAL

10.1.1 If one of the preferred systems is selected, then the following criteria shall apply. Where criteria are common for the various types of systems the same principles shall be used.

10.2 WATER SOURCE HEAT PUMP SYSTEM

10.2.1 In consultation with the Architect, Heat Pumps shall be installed in closets rather than above ceilings.

10.2.2 Heat Pumps shall generally be installed on the second level with an individual heat pump serving each occupied space.

10.2.3 Pumps serving a ground floor space shall be down flow type.

10.2.4 The use of silencers in supply and return duct is preferred to the use of lined ductwork.

10.2.5 Heat Pumps shall be fully ducted. The Closets shall not to be used as plenum chambers.

10.2.6 Where fresh air is ducted into heat pump return, a TAMCO 1000-volume control damper shall be installed.

10.2.7 The supply and return piping to and from each heat pump unit shall be complete with a shut-off valve on the supply line and circuit balancing valve on return and, if applicable, on the bypass.

10.2.7.1 Provide a strainer in common supply and return piping serving all heat pumps in one closet. Provide a shut-off valve in the supply and circuit balancing valve in the return.

10.2.8 Provide local disconnects for each unit, mounted on adjacent wall and NOT on the units.

10.2.9 All units shall be totally serviceable, for ease of air and filter change, pipe strainer cleaning and/or total replacement of the heat pump unit.

10.2.10 Heat source shall be generated by a minimum of two (2) boilers, circulating pumps, expansion tank, and all associated components, for direct injection into the heat pump loop.

10.2.11 Heat rejection shall be achieved by use of a high efficiency, plate type heat exchanger and circulating pumps connected to a remote mounted dry cooler, or an evaporative cooler complete with all necessary control valves.

10.2.12 If an evaporative cooling is used, automatic draining and non-chemical water treatment shall be used.

10.2.13 The thermal fluid between the plate type heat exchanger and the dry cooler or evaporative cooling tower shall be propylene glycol of the required strength for freeze protection.

10.2.14 Plain water shall be used in the main heat pump piping loop.

10.2.15 An adequate number of dampers for balancing purposes shall be provided in the ductwork distribution system from each heat pump unit.

10.2.16 Ventilation air shall be provided using heat recovery unit(s) either as a single unit or multiple units. The heat recovery unit shall utilize either heat wheel or thermal pipe heat recovery technology. The use of glycol run-around systems is unacceptable.

10.2.17 Ventilation air shall be tempered and any further heating shall be via the use of an indirect gas-fired heat exchanger or hot water heating.

10.2.17.1 Cooling of ventilation air shall be achieved through **using** chilled water **generated by** water-to-water heat pumps or DX systems.

10.2.18 Treated ventilation air shall be ducted either directly into the space, or ducted into the return air duct connection complete with manual damper to balance the quantity of ventilation air to each heat pump unit. Non ducted fresh air shall not be permitted.

10.2.19 The heat recovery unit shall be provided with an humidification system. Gas-fired humidifiers are preferred. Electric bottle type humidifiers are unacceptable.

10.2.20 The installation of heat pumps in corridor ceilings, storage areas may be considered ONLY if adequate space around the unit, including total access to the components is available for complete service and replacement of parts is available.

10.2.21 Ground floor areas such as Offices, Kindergartens, Classrooms, and Library with large windows shall be provided with wall-fin radiation or radiant heating panels.

10.2.22 Supplementary heat source shall consist of primary high temperature and secondary low temperature heating loops. The high temperature loop shall serve wall-fin radiation, convectors, force flow heaters, unit heaters, or radiant heating system, the low temperature loop shall serve shall serve the plate type heat exchanger associated with the heat pump.

10.2.23 Exhaust air from conditioned spaces shall be fully ducted to the heat recovery unit or to the atmosphere.

10.2.24 The ceiling space shall be used as a plenum for return air to the heat pump serving that specific area **with a ducted** return air connection within the heat pump closets to each heat pump unit.

10.3 GROUND SOURCE HEAT PUMPS

10.3.1 Same basic concept as outlined for the water source heat pump system except that the heat pump piping loop shall be connected to ground distribution system, rather than plate type heat exchangers and evaporative cooling tower or dry cooler.

10.3.2 Plain water shall be used in the heat pump piping loops.

10.3.3 The use of variable speed drive on the circulating pumps serving the heat pump piping loop, or use of occupied/unoccupied pumps shall be considered.

10.4 CHILLER/FAN COIL SYSTEM

10.4.1 A centrally located chilled water plant comprising of a centrifugal machine or multiple reciprocating compressors, water-cooled condensers, remote mounted cooling tower(s) (for summer operation only), circulating pumps and all associated components.

10.4.2 A packaged air-cooled chiller may be considered as an alternate.

10.4.3 Ceiling mounted (in corridors or within occupied spaces) fan coils with chilled water-cooling and heating coils to provide conditioned air to space.

10.4.4 Ventilation air shall be ducted to the return side of the fan coil unit with manual damper to FLUORESCENT balance the quantity of ventilation air to each unit.

10.4.5 Building heating shall be a combination of perimeter wall-fin radiation and heating coil section within the fan coil.

10.4.6 The use of a three pipe, or change over system shall not be permitted.

10.4.7 Exhaust ductwork shall be fully ducted from the conditioned space to the heat recovery unit or atmosphere.

10.4.8 Where a fan coil is installed in the ceiling space above the space it is serving, the ceiling space may be used as a plenum for return air. Provide return air inlet plenum with engineered intake and a fresh air connection each with a manual-balancing damper.

10.4.9 Install wall-fin radiation in all areas under large windows such as Offices, Kindergarten area, Classrooms, and Library.

10.4.10 Install force-flow heaters, unit heaters, convectors, or radiant heating system in Vestibules, Lobby areas, Corridors, Mechanical Rooms, Storage Rooms, and other areas as required.

10.4.11 Consultant may consider floor mounted vertical fan coil units in lieu of ceiling mounted.

10.4.12 Ventilation air shall be provided using HRV's as previously detailed in 10.2.16.

10.5 HEAT RECOVERY CHILLER/CONSTANT VOLUME TERMINAL REHEAT

10.5.1 Constant volume air systems may consist of the following:

10.5.1.1 A central air handling unit c/w return air fan, mixing box, filter, heating and cooling coils, humidifier and fan, supplying and returning air via ductwork distribution systems to exterior and interior zones

10.5.1.2 A centrally located chilled water plant, with double bundle condenser, capable of supplying low temperature hot water to each zone terminal reheat coil-

10.5.2 Gas fired boilers shall provide the supplementary heating serving perimeter radiation, unit heaters, force-flow heaters and convectors.

10.6 OTHER SYSTEMS

10.6.1 Multiple Rooftop HVAC systems with separate heat recovery units providing ventilation air.

10.6.2 Multiple roof-top, built-up HVAC systems with DX cooling, indirect fired gas heating, and controls.

10.6.3 Multiple indoor constant volume air handling units with hot water heating and DX or chilled water cooling with terminal reheat duct mounted coils serving each zone. A conventional gas fired boiler plant supplies hot water to unit heating coil, terminal re-heat coils, perimeter radiation units, force-flow heaters, unit heaters or radiant heating panels

10.6.4 Any other system that provides a guaranteed quantity of fresh air to all areas at all times under all circumstances. VAV, VVT, or any other VV system is not an acceptable alternative.

11 DEDICATED SYSTEM FOR GYM AND G. P. ROOM

11.1.1 The General Purpose Room (Elementary Schools), Gymnasium (Secondary Schools) shall be provided with a dedicated HVAC system.

11.1.2 Design criteria shall allow for 60 persons per gym; space temperature minimum 18.5^{o} C. maximum 23 ^{o} C and CO_2 control of OA,MA, EA dampers

11.1.3 Consider use of HRV in lieu of conventional air handling unit and return air fan.

11.1.4 No humidification is required.

11.1.5 Overhead supply air system should be perforated duct or conventional ductwork and diffusers, and low level return grilles/ductwork and/or in conjunction with high level propeller circulating fans to prevent temperature stratification.

11.1.6 Wall grilles shall be heavy duty for Gym use.

11.1.7 Diffusers shall be provided with safety chains on all removable parts.

11.1.8 Cooling shall be provided via chilled water coil, served by chiller or water-to-water H.P. system or DX system. Coil shall be installed within the AHU or HRU.

11.1.9 Heating shall be provided via a hot water coil or indirect gas-fired heat exchanger within the AHU.

12 HEATING APPLIANCES

12.1 WALL-FIN RADIATION

12.1.1 Elements shall be copper tubes expanded with aluminum fins.

12.1.2 Wall-fin enclosures shall be minimum 18 gauge, reinforced for rigidity, coated inside and out with corrosion resistant primer.

12.1.3 Wall-fin radiation element shall be provided under all windows and along exposed wall area, as required, to prevent the effects of cold radiation.

12.1.4 Pipework distribution shall provide for individual circuiting to each room with a reverse return pipe. Each radiation unit shall be controlled by a 2-way fully modulating valve in conjunction with any other system serving the space and with circuit balancing valve on return pipe connection. Where possible install modulating control valve in return water pipe in ceiling space of occupied space or adjacent corridor Provide a minimum of 457mm (18") high enclosure.

12.1.5 Install ball valve and circuit balancing valve in supply and return water pipe respectively serving each radiation within the enclosure with a 600mm (24") section access door to access all valves.

12.2 CONVECTORS

12.2.1 Convectors shall be fully recessed where possible.

12.2.2 Exposed, sloped top, type may be installed in storage areas.

12.2.3 Cabinets shall be constructed from 18g steel minimum, braced, and reinforced for stiffness. Front panel shall be 16g steel, minimum.

12.2.4 Install self contained automatic temperature control valves for each convector Installed in public areas (Corridors, washrooms, Stairwells)

12.2.5 Provide shut off and circuit balancing valve for each unit

12.3 UNIT HEATERS

12.3.1 Unit heater shall only be installed in Mechanical Rooms, Boiler Rooms, and Sprinkler/Water Meter Rooms and other designated areas.

12.3.2 Cabinets shall be minimum 18 ga. steel. Provide individually adjustable four-way louvered diffuser for complete control of airflow.

12.3.3 Unit shall be controlled by wall-mounted thermostat.

12.3.4 Provide shut off and circuit balancing valves for each unit.

12.4 FORCED FLOW HEATERS

12.4.1 Force flow heaters shall be installed in Entrance Vestibules, Lobbies, Corridors and other designated areas as required.

12.4.2 Enclosures shall be fabricated from minimum 16ga. steel. Fans shall be double inlet forward curved wheels, statically and dynamically balanced.

12.4.3 Provide 3-speed control, units suitable for 115/1/60 power supply.

12.4.4 Units shall be designed to operate on medium speed

12.4.5 Provide built-in thermostat to control the unit.

12.4.6 Provide shut-off valves and circuit balancing valve in the piping with access door at the floor level to service valves and fittings.

12.4.7 Consultant may consider incorporating 'Radiant Panel Heating Systems' similar to one manufactured by "Airtex" or approved equal in lieu of wall-fin radiation, convectors and force flow heaters. (Consultant shall discuss with the Board prior to selecting the type of heating system.)

13 BOILERS

13.1.1 Boilers shall be sealed combustion power vented type with stainless steel burners.

13.1.2 Boilers shall have a minimum efficiency of 85% and shall be capable of operating down to 40.5°C (105°F) without sustaining condensation.

13.1.3 A minimum of two (2) boilers shall be provided each with output at **66.6%** of the total heating requirements.

13.1.4 Boilers shall be either fully modulating (preferred) or stage control. No stage shall be greater than 25% of the system requirements.

13.1.5 Each boiler shall be complete with temperature and pressure gauges, flow switch interlocked with ignition system, low water cut-off and controls.

13.1.6 Division 17 shall be responsible for developing control of boiler sequence of operation

13.1.7 Fresh air shall be directly ducted into the boilers from the outside.

13.1.8 Venting of the boilers shall be as per manufacturer's recommendations. Under no circumstances shall the vents be reduced in size

13.1.9 Individual venting of a boiler in multiple boiler system is required.

14 CIRCULATING PUMPS

14.1.1 Provide two (2) pumps, one duty, and one standby, for each system.

14.1.2 Select pumps with non-overloading feature over the entire pump curve.

14.1.3 Pumps shall be selected with best efficiency, ideally not less than 60% and with low NPSH.

14.1.4 Pumps shall have 316 stainless steel shafts, bronze impellers, and mechanical seals.

14.1.5 Specify close-coupled in-line pumps for 2.25kW (3.0HP) or lower and split coupling in-line pumps for 3.75kW (5.0HP) and larger.

14.1.6 Specify 'Cuno' filter installed across flush line of mechanical seal, for split coupling in-line pumps.

15 DUCTWORK AND AIR DISTRIBUTION

15.1.1 Ductwork shall be constructed in accordance with the latest edition or SMACNA HVAC Duct Construction standards.

15.1.2 Drawings and/or specification shall clearly indicate the pressure classification of each section of a duct layout. Where NO pressure classification is shown, the duct shall be manufactured in accordance with the 250Pa (1"w.g.) positive or negative pressure classification rating described in the Standard. Sheet metal contractor should confirm reinforcement spacing option before commencing manufacture and installation of ductwork.

15.1.3 All ducts shall be minimum seal class C regardless of pressure class rating. Ducts subject to a pressure class rating greater than 250Pa (1"w.g.), positive or negative, shall be sealed in accordance with Table 1-2 in the Standard.

15.1.4 No duct leakage testing is considered necessary if the fan discharge or suction duct has a pressure classification of 750Pa (3" w.g.) positive or negative, or lower. However, if the Consultant specifically requests duct leakage testing to be performed, regardless of pressure classification, all tests should be carried out based on the application leakage class shown in Table 4-1 of the SMACNA HVAC Duct Leakage Manual.

15.1.5 Consultant should allow for leakage in ductwork based on the leakage class applicable regardless of an actual duct leakage test.

15.1.6 All duct sealing compounds shall be water based and have a Underwriter's Laboratories Rating of a Flame Spread of 5 and Smoke Developed of 0 when applied 0.020" thick as a minimum requirement.

15.1.7 Do not specify splitter dampers.

15.1.8 Spin-in connections for branch take-off are NOT acceptable.

15.1.9 Specify radius branch take-off.

15.1.10 Abrupt transitions are not acceptable.

15.1.11 Ductwork behind grilles or wall registers shall be painted black.

15.1.12 Ductwork serving dishwasher exhaust shall be constructed of stainless steel with welded joints. Slope ductwork toward dishwasher.

15.1.13 All shower room exhaust ducts shall be fabricated from aluminum in accordance with tables 1-21,1-22,and 1-23 of the SMACNA Standard and with longitudinal seams on the top. All joints shall be soldered and made watertight. Slope all ductwork towards exhaust grilles in shower rooms.

15.1.14 Provide balancing dampers in **each** duct system as recommended by SMACNA HVAC Design Manual, NEBB, AABC, to permit accurate balancing .

15.1.15 All balancing dampers in ducts with one dimension of 250 mm (10”) or larger shall be “Tamco 1000” multi-blade dampers.

15.1.16 Single blade dampers are acceptable in ducts where both dimensions are 200mm (8”) and smaller as manufactured by Tamco.

15.1.17 If an alternate to “Tamco 1000” is specified, the performance, construction and features of the specified damper shall exceed the specifications of “Tamco 1000”.

15.1.18 All damper hardware, linkages, and actuator shall be installed exterior to the duct, with flanged connections. Provide access doors for all dampers.

15.1.19 All hangers and supports shall be in accordance with Section 4 of the Standards

15.1.20 All exterior louvers shall be of 12-gauge construction and of storm proof type, of anodized aluminum in accordance with SMACNA Standards.

15.1.21 Louvers shall be supplied complete with 16-gauge 13mm (½") mesh aluminum bird screen in accordance with SMACNA Stanadards..

15.1.22 Specify condensate drains at low points, complete with trap, on all outdoor air plenums and any duct subject to moisture collection. Run drains to floor drain.

15.1.23 All fan suction and discharge duct connections shall be heavy-duty canvas or neoprene glass fiber fabric material, minimum width 150mm(6") and shall not contain asbestos.

15.1.24 Kitchen exhaust ducts shall be designed to NFPA-96 code, latest edition.

15.1.25 Seal and weatherproof ducts passing through roof. Solder all joints and seams. Degrease, prime, and paint any ferrous counter flashings.

15.1.26 Form ducts with gauge markings on exterior of ductwork visible from floor.

15.1.27 Maximum aspect ratio of any duct shall not exceed 4:1 .

15.1.28 Make radius of turns at least one duct width.

15.1.29 Where space prevents such radius turns, 90° turns with turning vanes of double-faced hollow type with "Duro Dyne" vane-rails secured with sheet metal screws shall be used.

15.1.30 Square throat, radius back bends are not permitted.

15.1.31 Select grilles and diffusers for distribution and throw within sound criteria.

15.1.32 Specify that Transition ducts shall not have more than 30-degree slope to full size of each grille, register, or equipment.

15.1.33 Flexible duct installation and standards shall conform to section 3.5 of SMACNA Standard.

15.1.34 Flexible ducts shall be either metallic, uninsulated or metallic insulated. The use of non-metallic, uninsulated or insulated flexible ductwork shall not be permitted.

15.1.35 Joining and attaching flexible duct shall be in accordance with section 3.6 of SMACNA standard.

15.1.36 Maximum flexible duct connection to diffuser shall be 2m (6ft) in total length.

15.1.37 Flexible ducts shall be supported in accordance with section 3.7 of SMACNA Standard and/or fig 3-9 and 3-10.

16 INTAKE, EXHAUST AND RETURN AIR DAMPERS

16.1.1 All fresh air intake and exhaust air dampers associated with Air Handling Units (AHU'S) or Heat Recovery Units (HRU'S) shall be 'TAMCO 9000'.

16.1.2 Return air dampers in an AHU or HRU shall be 'TAMCO 1000'. No alternatives are acceptable.

16.1.3 If a AHU or HRU manufacturer cannot provide TAMCO then they shall not be eligible to be included in the specification.

17 DIFFUSERS, REGISTERS AND GRILLES

17.1.1 Select square or round diffusers to provide even air distribution throughout the space without creating drafts or noise problems. All diffusers shall be of adjustable pattern, panel type and of steel construction.

17.1.2 Air diffusion equipment serving humid areas shall be of aluminum construction.

17.1.3 All linear type air diffusers shall have plenum boxes, sized in accordance with manufacturer's recommendations, to ensure proper air distribution.

17.1.4 All grilles and registers shall be double deflection type with adjustable front louvers parallel to the longest dimension, and adjustable rear blades.

18 DRAINS AND VENTS

18.1.1 All piping systems including coils shall be drainable and shall be provided with air vents.

18.1.2 Drain piping shall be equipped with hose valves with caps and chains.

18.1.3 Air vents shall be automatic types wherever possible. All automatic air vents are to be piped to the nearest funnel floor drains. Manual isolation valve is to be provided for each air vent.

19 PIPING AND FITTINGS

19.1.1 Distribution system shall be two-pipe reverse return piping system wherever possible. Unions, shut-off valves, strainers, and circuit balancing valves shall be installed on branch piping serving each piece of heating and cooling equipment. A drain valve with hose end connection,, chain and cap shall be installed at each item of equipment and at all low points in the distribution system.

19.1.2 For pipes 50mm (2") and smaller, use Schedule 40, continuous welded black carbon steel piping conforming to ASTM-20, A.53. Fittings shall be 1035kPa (150psi) standard black malleable iron screwed type, unions shall be 1035kPa (150psi) malleable iron construction with brass to iron ground joint and screwed ends.

19.1.3 Alternately for pipes, 50mm(2") and smaller, use type 'L' hard drawn copper tubing conforming to ASTM B.88. Fittings shall be wrought copper or brass solder joint pressure type. Unions shall be all brass construction with solder joints. May be specified for terminal connections to specialist pieces of heating or cooling equipment.

19.1.4 For pipes 63mm (2½) and larger, use Schedule 40, continuous welded steel to ASTM A.53, grade 'B' with beveled ends. Fittings shall be 1035kPa (150psi) Schedule 40 seamless carbon steel butt-welding fittings. Flanges shall be forged steel slip-on weld neck raised face type. Use long radius elbows wherever possible.

19.1.5 All strainers shall be flanged iron body y-type stainless steel screen with screwed ends on 50mm (2") and smaller pipework, flanged iron body on 63mm (2½) and larger pipework.mesh to suit service. Each strainer shall be fitted with "construction" filter mesh and changed to suit service after system has been flushed prior to permanent use.

19.1.6 Victaulic piping, couplings and valves may be used as an alternate. Consultant shall discuss with the Board prior to specifying.

19.1.7 Use di-electric fittings where dissimilar piping materials are connected.

19.1.8 Piping shall not be installed buried underground unless necessary. Where this must be done due to special site conditions, tunnels of adequate sizes, or trenches with continuous access, shall be provided for servicing and maintenance.

19.1.9 Alternately, pre-insulated pipework fabricated from material that allows direct burial could be used. Any such piping system shall be installed on a suitable bedding material and covered with a fine

material for a minimum 150mm (6”) depth prior to final cover material being installed. Any such system shald be installed to allow for any expansion or contraction without the use of bellows type expansion joints and pipe guides

19.1.10 All piping suspended in Mechanical Rooms; subject to vibration with a minimum static deflection, 25mm (1”) shall be installed with spring hangers to prevent any vibration being transmitted to the building structure.

19.1.11 Strainers shall be installed in the suction line of all pumps, and ahead of all 2 and 3-way control valves.

19.1.12 All heating systems shall be designed to allow the entire system to be drained completely via risers.

19.1.13 Exterior pipe work on roofs shall be installed on purpose made pipe roller stands manufactured by Portable Pipe Hangers (Canada) type SS8R with clamp (Super Sleeper's) - www.portablepilehangers.com. Refrigeration pipe work and Electrical Conduit use SS8C for pipe over 3" openly PPH-RB18 with clamp or other applicable support Manufactured by PPH.

20 SERVICE AND ACCESSIBILITY

20.1.1 All equipment shall be fully accessible for servicing The Consultant shall ensure that adequate access doors are provided in each system and that maximum permissible space is provided around the equipment for servicing. All access walkways shall be free from any tripping hazards or overhead obstructions.

20.1.2 Steel structural catwalks, access platforms etc. shall be provided for servicing all equipment that is installed over 2m (6'-0") from the finished floor.

20.1.3 All mechanical equipment shall be located to allow for future removal and/or replacement without demolition or removal of adjacent equipment or building structure.

20.1.4 All access doors shall be gasketed. Access doors shall be at least 300mm x 300mm and shall be provided at the following locations as a minimum requirement:

20.1.4.1 Upstream and downstream of each cooling and heating coil.

20.1.4.2 Wall-fin radiation, force-flo heaters ,fan convectors, convectors for access to valves and controls.

20.1.4.3 Fire damper locations.

20.1.4.4 In drywall ceilings for access to any concealed equipment.

20.1.4.5 All balancing damper locations.

20.1.4.6 Any other mechanical component in any system that requires service and adjustment.

21 EXHAUST FANS

21.1.1 Roof mounted centrifugal exhaust fans, except those serving service areas, shall be equipped with motorized TAMCO 9000 Series dampers. Minimum height of roof curb shall be 457mm (18”).

21.1.2 Select belt driven fans to operate at speeds less than 1400 RPM and direct driven fans not greater than 1550rpm.

22 ELECTRIC MOTORS AND STARTERS

22.1.1 All electric motors >0.33KW (0.5HP) shall be high efficiency types and shall meet or exceed Ener-Mark Efficiency level for their particular class of speed and horsepower.

22.1.2 All motors exposed to air streams or where used in outdoor applications shall be totally enclosed fan cooled (TEFC) type.

22.1.3 Motors 7.5KW (10HP) and larger shall be provided with reduced voltage starters.

22.1.4 Starters requiring interlocking shall be magnetic type with control voltage relays for interfacing with Building Management Systems.

23 EXPANSION TANKS

23.1.1 Expansion tanks shall be pressurized diaphragm type, pre-charged at factory. The air charge shall be equal to the minimum operating system pressure of hot water heating system or other applications.

23.1.2 Tank shall be ASME rated, constructed for maximum working pressure of 862kPa (125psi) and a maximum temperature of 115°C (240°F).

23.1.3 Tank shall be complete with pressure gauge.

24 CHEMICAL TREATMENT

24.1 GENERAL

24.1.1 Mechanical Contractor shall engage the services of Industrial Treatment Solutions (1-905-686-8778) to oversee the cleaning of all piping systems. Contractor shall also be responsible for the purchase of all necessary cleaning chemicals from Industrial Treatment Solutions. No alternatives shall be acceptable.

24.1.2 Contractor shall clean all filters, strainers, and strainers and replace cartridge filter elements at time of substantial completion and at one month after occupancy.

24.2 CLOSED SYSTEMS

24.2.1 All new piping systems shall be cleaned chemically and thoroughly flushed before filling with permanent thermal fluid. After systems are filled up, a chemical water treatment program shall be implemented to control corrosion and scale build-up.

24.2.2 Chemical pot feeders shall be installed for closed loop systems.

24.2.3 Install a Hayward/Eaton Flowline **2" FBF-0102-AB** Filter in all closed loop systems. Provide 6 spare 10 micron bags and 6 spare 5 micron bags. Contractor is to include min of 4 bags of each micron to initially clean the system. After use the bags shall be inspected by the Water Treatment Company specified before certificate of cleanliness is given.

24.2.4 Contractor shall provide all necessary chemicals for all systems for a period of one (1) year. During this period, the Contractor and/or chemical supplier shall make a minimum of three (3) visits, review the system, take water samples, and submit reports.

24.2.5 Industrial Treatment Solutions shall supervise the flushing and cleaning of all systems and issue a report confirming that he has witnessed cleaning of all strainers, and installation of permanent mesh screen in strainer, supervised removal and replacement of cartridge filters and that the systems are clean and suitable for operation.

24.3 OPEN SYSTEMS

24.3.1 Industrial Treatment Solutions (1-905-686-8778) shall be responsible for supplying all chemicals for cleaning and supervision of cleaning and flushing of all pipework systems. No alternatives

shall be allowed**.** Issue a report confirming that the cleaning and flushing has been completed.

24.3.2 All open systems shall have a non-chemical corrosion control system supplied and installed by supplied and installed by Dynamic Cooling Tower Systems Inc. (416-605-7740) No alternatives shall be allowed.

25 IDENTIFICATION

25.1.1 All valves including circuit balancing valves shall be numbered and tagged using 25mm (1") diameter brass tags and brass chains. A glass-framed copy of the valve chart(s) shall be provided in the Main Mechanical Room/Boiler Room.

25.1.2 All equipment, control panels, starter panels, dampers etc. shall be name tagged using 3.8mm (1.5") high Lamicoid plates. Large equipment, such as heat recovery units, air-handling units, condensing units, expansion tanks, and circulating pumps shall be name labeled using stencils with 63mm (2.5") high lettering. or purpose made pressure sensitive stock marker labels manufactured by W. H. Brady

25.1.3 All services shall be identified using stencils with 50mm (2") lettering or color-coded and identified. Identification shall be placed at minimum 3m (10ft) intervals and shall also show direction of flow. Minimum lettering size shall be 50mm (2").

25.1.4 Alternately pipes shall be identified using purpose made stock pressure sensitive pipe markers or stock Brady snap-on pipe markers manufactured by W. H. Brady

25.1.5 Direction of flow shall be provided on all services, using either stenciled on arrows, or manufactured, self-adhesive pipe markers manufactured by W. H. Brady.

25.1.6 All ductwork in mechanical rooms shall be identified using with minimum 63mm (2.5") high lettering. Direction of flow shall be marked.

26 COLOUR CODING

26.1.1 Where the project involves building additions, all system tagging, and identifications shall follow existing colour coding, and the numbering sequence extended to the new additions.

26.1.2 For new projects, the following colour-coding shall be used for the various services:

TYPE OF PIPING	COLOUR CODING	VALVE TAG LEGEND
Heating Supply	Red	HTGS
Heating Return	Red	HTGR
Heat Pump Water Loop	Orange	HPW
Gas	Yellow	G
Steam	Yellow	STM
Condensate	Yellow	COND.
Chilled Water Supply	Blue	CHWS
Chilled Water Return	Blue	CHWR
Refrigerant Suction Line	Yellow	REF.S
Refrigerant Liquid Line	Yellow	REF.L
Condenser Water Supply	Light Green	CWS
Condenser Water Return	Light Green	CWR
Vent (Plumbing	Green	V.P.

27 PROTECTIVE GUARDS

27.1.1 Any rotating device shall be guarded to comply with Ontario Ministry of Labor's Finger Test. All manufacturers of equipment shall ensure that any protective guard complies with the Ontario Ministry of Labor's Finger Test. All shaft ends shall be guarded. Any equipment using the casing as a guard shall have a *'Notice of Warning'* affixed to the access panel.

27.1.1.1 This provision shall apply to all equipment irrespective of

location or height above floor particularly unit heaters installed at high level.

28 THERMAL FLUID

28.1.1 All antifreeze solutions shall be propylene glycol. DO NOT USE ETHYLENE GLYCOL.

28.1.2 A glycol-mixing tank complete with rotary hand pump and/or electric gear pump and manual switch and all other components shall be installed for maintaining the correct specific gravity and anti-freeze temperature.

28.1.3 An automatic fill system and pressure switches shall not be allowed

29 THERMOMETERS AND GAUGES

29.1.1 Gauges and thermometers shall register both in Imperial and Metric units.

29.1.2 All compound (vacuum to positive) pressure gauges shall be complete with vibration snubbers. Where gauges are installed to read differential reading across a pump assembly, the gauges shall be piped to read pressure drop across the strainer only or pump only and/or combined pump and strainer assembly. Provide ball valves or needle type valves for isolation.

29.1.3 All pressure gauges shall have a minimum dial diameter of 115mm (4.5").

29.1.4 Thermometers shall be adjustable angle types or rigid type to suit application. .

29.1.5 Thermometers shall be 230mm (9") scale, installed in separable brass oil filled wells.

30 VALVES

30.1.1 All valves shall be of rising stem type with 860kPa (125psi) rating or more. Packing material shall NOT contain asbestos.

30.1.2 By-pass valves around control valves, PRV's shall be globe type.

30.1.3 Where flow measurement is required for any piece of equipment, control valve or piping distribution system, circuit balancing valves shall be installed in accordance with manufacturer's recommendations. Circuit balancing valves shall be manufactured by S. A. Armstrong; Tour and Anderson or Taco.

30.1.3 Main isolation valves that cannot be operated from floor level shall be provided with chains.

30.1.4 All gate and globe valves under 50mm (2") shall be of all-bronze construction, screwed connection with bronze disc. Ball valves may be used in lieu of gate valves for sizes 50mm (2") and under.

30.1.5 All gate and globe valves 63mm (2 ½") and larger shall be flanged type, OS&Y, iron body, bronze mounted.

30.1.6 Check valves shall be non-slam, silent type.

30.1.7 Butterfly valves in sizes 75mm (3") and larger valves shall be flanged or full lug type, iron body, bronze disc, 316 stainless steel stem, and full EPT liner. Valves shall be lever operated for sizes 125mm (5") and under and gear operated for sizes 150mm (6") and larger, with valve position indicator.

30.1.8 All strainer blow-down valve piping shall be piped to floor drain.

30.1.9 All pumps assemblies shall be installed with suction diffuser/strainer and triple duty valves on discharge.

31 SLEEVES

31.1.1 All pipes and ducts shall be sleeved as they pass through walls, floors, ceilings, and partitions.

31.1.2 All sleeves shall be of Schedule 40, steel pipe except **where passing through** walls below grade and waterproofed walls, when sleeves shall be of extra heavy cast iron.

31.1.3 Sleeves shall be concentric with pipe. Split sleeves shall NOT be used.

31.1.4 Sleeves shall be sized to permit continuity of pipe insulation through sleeves.

31.1.5 Pack all sleeves between pipe or insulation and sleeve with loose fiberglass insulation and sealed with approved fire resistant compound at both ends.

32 EQUIPMENT LIST:

32.1.1 The following is a list of acceptable suppliers of Mechanical equipment. Substitutions, if any, must be approved by the Board no less than ten (10) days prior to tender closing.

PRODUCT	LISTED SUPPLIERS	
Valves/Brass	Crane Keystone Newman Hattersley	Jenkins DeZurik Toyo
Valves Butterfly	Crane Newman Hattersley DeZurik	Jenkins Keystone
Access Doors	Acudor Mifab LeHage	Zurn Nailor-Hart
Circulating Pumps	Armstrong Bell & Gossett	Taco
Grilles & Diffusers	E.H. Price Carnes	Titus Nailor-Hart
Exhaust Fans, Intake/Relief Ventilators	Greenheck Carnes,Zonex	Penn (Airex)Jenn
Fire Dampers	Controlled Air Ruskin	Nailor-Hart
Thermometers and Gauges	Trerice Weksler Taylor	Winters Ashcroft
Silencers/Vibration Isolation	Vibro-Acoustics Vibron	(BVA Systems)
Chemical and Non Chemical Feed System	Dynamic Cooling Tower Systems Inc. Industrial Treatment Systems	

Boilers (Hot Water)	**Camus** Raypak,	Teledyne-Laars Dietrich
Wall-Fin Radiation, Convectors, Force Flow Heaters, Unit Heaters	**Engineered-Air** Vulcan Rosemex	 Sterling Trane
Heat Recovery Unit	**Engineered-Air** Haakon	
Air Handling Unit	**Engineered Air** York Trane	**Haakon** McQuay Carrier
Split Systems HVAC System	Carrier McQuay	Lennox Engineered Air
Cushion Tanks	Armtrol Expanflex	Taco Bell & Gossett
CO Detection System	Enmet Vulcain (Airex)	Armstrong
Expansion Hoses & Joints	Flexonics United Flexible Pathway	Anaconda Vibra-Flow
Strainers/steam traps	Sacro Dunham-Bush Armstrong	Erwel Trane
Chillers	Carrier York	Trane

Fan Coils	Trane York International	Carrier McQuay
Heat Pumps	**Florida** Water Furnace Mammoth	Carrier Climatemaster
Evaporative Coolers/Cooling Towers/Dry Coolers	Baltimore Air Coil Evapco Blanchard Ness	
Roof Top Units	Carrier Trane York	Engineered Air Lennox
Unit Ventilators	Venmar HTS (Changeair)	
Radiant Panels	Airex Frenger Ceiling	
Circuit Balancing Valves	**S.A. Armstrong** Tour & Anderson	
Heat Exchangers	S.A. Armstrong Alfa-Laval ITT (Bell & Gossett)	
Humidification System (Gas-Fired)	Nortec Dri-Steem	
Pipe Labels	Mystic Westline Brady	

Manufacturers in **Bold** are preferred suppliers.

33 NOTES TO CONSULTANTS

33.1.1 Add to ‘Product List’ as required

33.1.2 The ‘Base Bid’ product specified by the Consultant shall appear as the first item in the list and shall be in bold letters.

33.1.3 Consultant to decide which of the listed products should be used as ‘Base Bid’ and which products should be specified as ‘Equal’ or as acceptable alternate.

END OF HEATING, VENTILATING AND AIR CONDITIONING GUIDELINE

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